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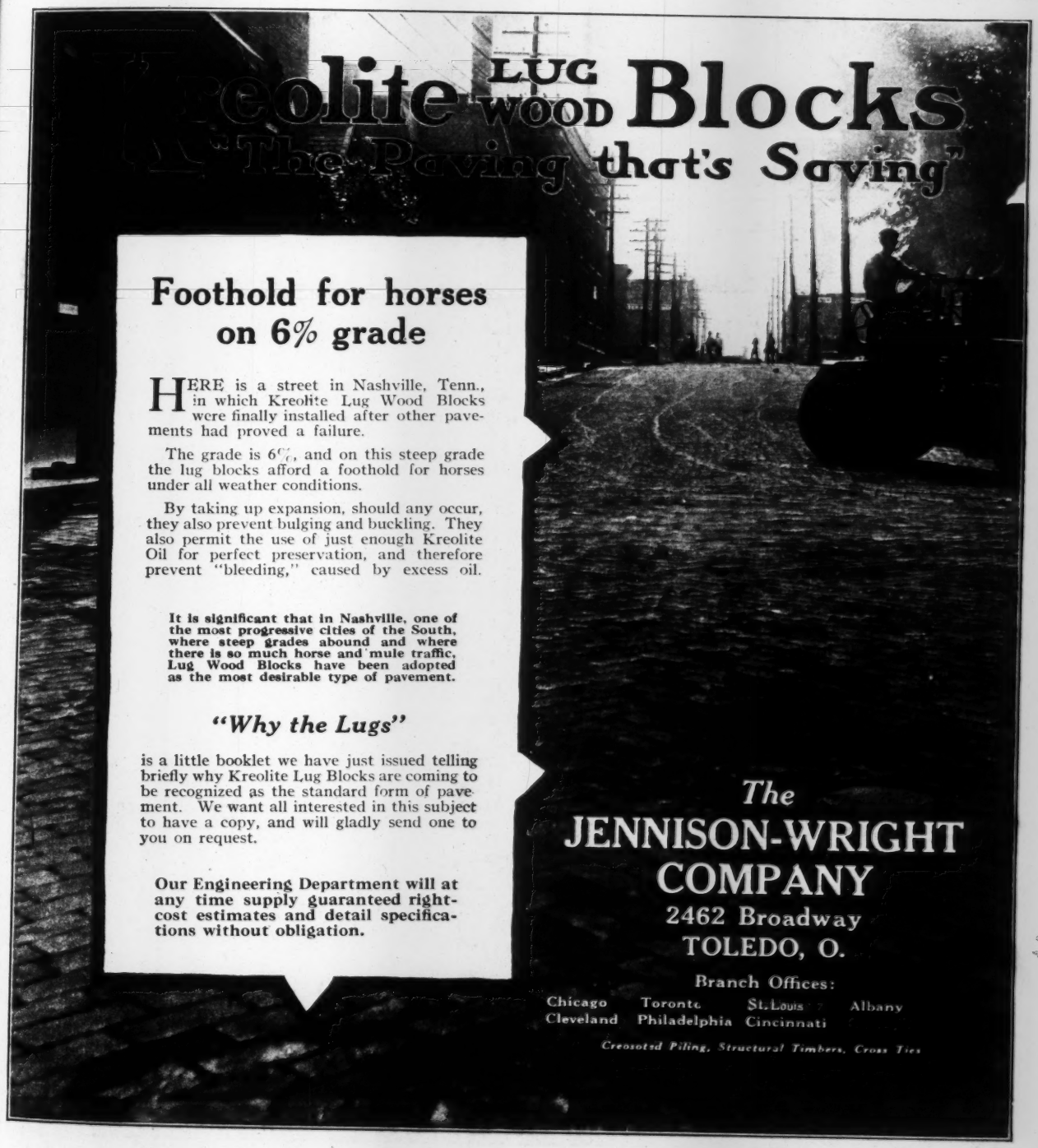
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Piling driven by C. A. Dennis, Buffalo, N. Y.

This dam which is economical and was quickly constructed without the use of cofferdams was designed by New York State Engineers to replace an old wooden structure that regulates the level of the western end of the Erie Canal.

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Engineering News

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Travis Tank and Sprinkling Sewage Filters, Paqueta Island, Rio de Janeiro

By Charles J. Seiber*

The Bay of Guanabara, on which the City of Rio de Janeiro is situated, is a body of water some 50 km. long and varying in width from 5 to 16 km. The entrance is quite narrow, and no river of any size discharges into it; but it receives the sewage from a population of well over 1,000,000. This body of water is one of the most beautiful in the world, and the authorities are very careful to adopt measures that will prevent the contamination of the bay.

Many of the islands that dot the bay are quite large and contain small villages. The Island of Paqueta, near the head of the bay, about an hour's sail by steamboat from the city, contains a community of approximately 5,000 people, and some 400 houses are connected to the separate system of sewers that has been laid through the island.

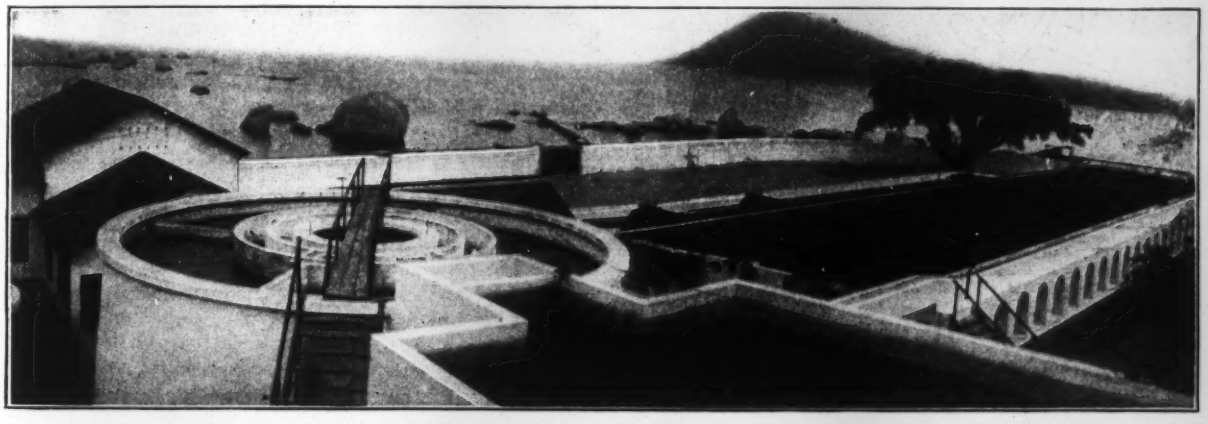


FIG. 1. GENERAL VIEW OF SEWAGE-WORKS OF ISLAND OF PAQUETA, RIO DE JANEIRO, BRAZIL

All the laterals feed into a main intercepting sewer, which contains four automatic pumping stations operated by electric motors, the office of these pumping stations being to raise the sewage from low to high level, whenever the elevation of the main interceptor falls to a point where its further continuance would carry it to too great a depth below grade.

The last of these stations pumps the sewage to a small settling tank. The outflow from this tank is controlled by automatic valves that feed the raw sewage to a circular Travis tank, constructed after the plans of the Hydrolytic Tank Co., of England. The effluent from this tank goes to sprinkling filters. Fig. 1 is a general view of the tank and filters, and Fig. 2 shows the details of the tank.

There are practically no trade wastes, the sewage coming almost entirely from residences with wide variations in the rate of flow. At the time of the writer's visit to the plant in January, 1916, the water-supply of the island was not up to normal, and the sewage could be classed as "strong." It was noticed that the raw sewage contained much solid matter and was almost black in color and fresh. The Travis tank showed very little scum and hardly any gas, and a marked progressive clarification was noted at each succeeding weir and an entire absence of odors. At the final outfall from the tank the effluent was quite clear, having somewhat of an amber color, but there still remained flaky solids, to a slight degree, the largest of these flakes being not over a half a centimeter in diameter and only a fraction of a millimeter in thickness.

After leaving the Travis tank the effluent passes into a channel at one side of a high-level sprinkling filter. A siphon, at one end of a traveling distributor, carries the effluent to the distributor pipes. The distributor (Figs. 1 and 3) is moved on three rails and covers the entire filter bed, which is 10 m. wide by 45 m. long. The distributor feeds only one-half of the bed, when running in either direction, the change-over being accomplished by a length of pipe partly filled with heavy oil.

When the carriage arrives at one end of the bed, it engages with stops that release one cable grip and engage another taking the rope traveling in the opposite direction. This is accomplished by means of the oil-filled

*Resident Engineer, Trussed Concrete Steel Co., Candelaria 2, Rio de Janeiro, Brazil.

counterbalance shown in Fig. 3, which after being brought to a level position by the stops is carried positively to its extreme position by the shifting of the oil in the pipe. This motion also operates gate valves on the carriage, which cuts off the effluent from one half of the distributor and admits it to the other half. By this means each half of the bed is closed at each passage of the distributor and is rested during the return passage. The distributor is operated by an endless wire rope driven by a 5-hp. electric motor, both the upper and lower filter beds being operated by the same motor. After passing the first, or high-level, filter very little solid matter remains, and the effluent appears to be colorless in the discharge weir.

From the high-level filter the effluent passes to the low-level one, which is an exact counterpart of the first. When

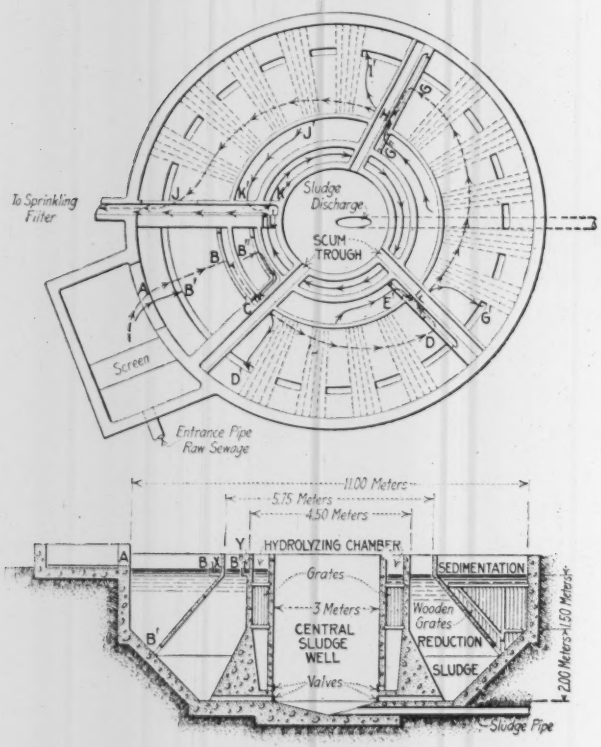


FIG. 2. PLAN AND SECTION OF TRAVIS TANK, PAQUETA SEWAGE-WORKS

A—Entrance weir to first sedimentation chamber. B—Weir to channel "x," from first reduction chamber. E'—Openings to first reduction chamber. C—Siphon to second sedimentation chamber. D'—Openings to second reduction chamber. D—Weir from second sedimentation chamber. E'—Weir from second reduction chamber. F—Siphon to third sedimentation chamber. G'—Openings to third reduction chamber. G"—Weir from third reduction chamber. G—Weir from third sedimentation chamber. H—Siphon to fourth sedimentation chamber. I'—Openings to fourth reduction chamber. J—Weir from fourth sedimentation chamber to outflow. K' K"—Siphon from fourth reduction chamber to hydrolyzing chamber. L'—Weir from hydrolyzing chamber to outfall. B"—Weir from first reduction chamber to channel "y"

the liquid discharges from the latter bed, there is not the slightest trace of solids or of odor, and in the channels no color can be seen. The writer held a glass of effluent against the white walls of the filter and could detect no trace of color, but on looking down through about 20 c.c. of liquid placed on a white paper a very faint yellow tinge could be detected. A bottled sample after one week was absolutely odorless.

The outfall to the sea may be seen in Fig. 1, just at the right of the gate in the wall surrounding the property. The beach here has a slight slope only, with hardly a meter of tide. An examination of the rocks in the vicinity showed no signs of deposit. The sea was quite clear and the beach in front of the plant was being used by several bathers.

From all indications the plant appears to accomplish the desired results perfectly. No disinfection is used. The operator informed the writer that the sludge, of which there was a very small quantity, was removed two or three times a month and buried on the property. He had the day before our visit removed sludge and deposited it in a shallow excavation, at the left of the large tree appearing in Fig. 1. This sludge was uncovered and was absolutely odorless and inert.

The power house (at the left of Fig. 1) contains two Diesel engines direct-connected to 500-volt direct-current

FIG. 3. VIEW OF TRAVELING SEWAGE DISTRIBUTOR, PAQUETA SEWAGE-WORKS

generators, a very complete switchboard and recording devices and a storage-battery plant.

All machinery is of British manufacture. The complete system is cared for by six employees and is splendidly maintained, being a model of its kind.

The system was built and is operated by the Rio de Janeiro City Improvements Co., which controls and operates the complete drainage system of Rio de Janeiro. The writer is indebted to the company for its courtesy in allowing him to inspect and photograph the plant.

How Can the Engineer Improve His Public Standing?

By F. W. Hanna*

The engineer's standing (or lack of standing) in the public mind and in public affairs is due to (a) the nature of engineering work, (b) the public's method of valuing men and (c) the character of the engineer's education. The first of these causes is not susceptible of such changes as will materially affect the engineer's public status, but the second and third are not so strictly limited.

The remoteness of the benefit to be derived from a piece of engineering work makes its importance indistinct to the public vision. The design of a bridge is so far removed from its use in traffic that the public seldom connects the engineer with commerce and human travel; the survey of a reservoir site is not vividly enough related to the growing of crops on an irrigation project or the use of water from a faucet in the house to make vivid in the mind of the public the usefulness of the engineer.

*Consulting Engineer, United States Reclamation Service, Ankeny, Iowa.

Neither does the hazy concept of the part taken by the engineer in these enterprises permit the public to appreciate the amount of intelligence and labor devoted to the design and the survey.

These illustrations are typical of practically all engineering operations. The engineer is assumed to evolve railroads, power developments and irrigation projects as an ordinary, easy natural process. His unseen mathematical calculations pass with the public as rapid addition at best, and his fieldwork as mere ability to run a compass. The insight is little deeper than the public's knowledge or its tangible experience. This phase of the nature of engineering work is worthy of consideration, however, as the engineer must cope with it, and he should do it understandingly.

The public method of human valuation is generally imperfect, because its conclusions are usually drawn from a partial knowledge of the facts. Its facilities, time and ability for securing complete premises for conclusions are all limited. The public necessarily consists of a mixture of individuals with varying mental dimensions and varying education, all intensely employed in their own affairs. The public seldom searches deeply for facts, and it is impressed on the average only by obvious truth. This is why all reforms are so painfully slow in realization and is also why the services of the engineer to humanity are little understood and poorly appreciated. The engineer's only remedy for this trouble is to get the facts before the public so that they will be obvious to it, through use of the press, the school, the rostrum and literature.

The school, the press, the public rostrum and literature are the main sources of public information outside of the experiences in the daily routine of life. The public is ready to read entertaining newspaper accounts of engineering works, and the scenes of a play or the plot of a novel can well be centered about some great piece of engineering work. Few engineers can succeed in writing plays or novels; and were they to do so they would turn their talents in that direction, as did Robert Louis Stevenson and F. Hopkinson Smith. The engineer, however, may endeavor to interest writers intelligently in the human as well as the material side of his work, and he may also improve opportunities to lecture on engineering and related subjects, with resulting benefit.

Faced by such a literary and oratorical program the engineer will often shrink, rightfully from objection to self-advertisement, but wrongfully from fear of commercialization of his profession. Moreover, he generally feels incompetent to carry out his part in such a program, from lack of college training along certain lines. This indicates where some changes in our college engineering courses would be helpful.

The engineer on leaving college is not well balanced educationally. He is well equipped to grapple with the laws of nature, but not with those of human nature. He has been trained thoroughly, and rightly so, in all the natural, rational, pure and applied sciences, but generally he has had only a smattering of English, supplemented with a like smattering of German or French or Spanish. He knows but little psychology, political economy and sociology, but little law, too little of anything in fact that gives him an insight into human affairs outside of his own profession.

The college courses are only partly to blame for this state of affairs. The engineering student almost always sees his chosen profession too narrowly and avoids and slights the broadening subjects in his course of study. He conceives his profession to be that of converting the raw materials and potent forces of nature into human use, without seeing the necessary intervening and important conversion of his fellow beings into supporters of his projects. After some years of experience he learns that the latter is one of the big factors in his profession and then wishes that he could understand human nature and speak and write better.

The study of French or German or Spanish has a fine theoretical basis for its future utility in the engineering profession. A few of our engineers read engineering literature directly in these foreign languages, but most of us soon forget how to read them and depend on translations for their foreign information. A few of our engineers go into foreign lands and use directly the foreign languages learned in college, but the great mass of them find employment in their own country. Consequently, the large majority of engineers receive practically no other benefit from the study of foreign languages than that of general mental culture.

On the other hand, this large majority would receive the same mental culture and also an immense practical benefit through the substitution of a more thorough study of the English language and its literature. Let the engineer have enough rhetoric to make his tongue and pen certain of their ground, enough debating and oratorical work to induce a natural flow of speech while standing before an audience, and enough literature to loosen his poetical imagination and awaken his interest in the higher relations of mankind. He will then be better fitted to take his proper place in public affairs.

An intimate acquaintance in college with the fundamental laws of the human mind and with those of human society would be of profound service to the engineer in his dealings with the public. An understanding of these laws is just as essential to successful dealings with the public as is an understanding of the laws of inanimate nature and mathematics to the efficient handling of the material problems of engineering.

Due to his college training in mathematics, physics, mechanics, chemistry and the like, the young engineer readily and quickly manages problems involving their use. Occasionally an engineer has acquired an understanding of these fundamentals in his busy life of practice, but he was handicapped for their lack during several of the most useful years of his life. The engineer graduate now suffers a similar handicap in his knowledge of the human mind, human society, human institutions. He is compelled to buffet against the world for a long time before he is equipped to handle a position involving serious dealings with the public. While more liberal college training in psychology, sociology and political economy would not eliminate all of this buffeting, it would greatly lessen the length and severity of the apprenticeship.

The engineer's analytic habit of mind, his accuracy of thought and his honesty of purpose are excellent qualities for men in public service; but greater endeavor on the part of the engineer to secure public appreciation and better preparation of engineer graduates in their college work for public service will aid greatly in enlarging the engineer's share of appointments and elections to positions of public authority and influence.

Operating a Steel-Sharpening Shop

First-Prize Drill-Sharpening Article in the "Engineering News" Prize Contest

By J. E. O'Rourke*

Those engaged in rock excavation are beginning to realize more clearly every day the need of a well-equipped blacksmith shop for sharpening rock-drill bits. When hammer water drills were adopted at the Wisconsin Zinc Co.'s mines near Platteville, Wis., the management realized that hollow high-carbon drill steel required much greater care in handling than the solid steel formerly used with piston drills. Considerable thought was given this matter, resulting in the erection of a new blacksmith shop at the Champion mine. The site of this shop was carefully selected so as to be as nearly centrally located as possible, in order to furnish steel to four mines—namely, the Champion, Longhorn, Thompson and the Winskell.

Appreciating the fact that four mines were liable to keep the blacksmith very busy, the writer endeavored to arrange the shop equipment in such a manner as to avoid excessive handling of steel. With the idea of getting the greatest efficiency as regards the heating and the making of drill bits and shanks it was decided to install a Denver Fire Clay Co.'s oil forge and a Sullivan sharpener.

Attention is called first to the rack, Fig. 1, for dull steel from the Champion mine, the shaft of which is located about 50 ft. from the south end of the shop. When the dull steel is hoisted from the Champion shaft, it is carried to the shop, and each length is placed in the respective compartment allotted for it on the dull-steel rack, the longer lengths being placed in the lower compartments.

The movement of the steel through the shop from this point is as follows: From the dull-steel rack it goes to the upper deck of a double-decked stand in front of the oil forge, as shown in the plan, Fig. 3.

The fire opening in the oil forge is of sufficient length for placing nine steels in the fire at once. The writer experimented with different forging heats and, contrary to the recommendation of the steel manufacturer (which was 1,500° F.), it was determined that the most satisfactory forging heat was close to 1,650° F. A Wilson-Mauelen base-metal pyrometer was used. The fire end of this pyrometer was held in position in the fire by means of a home-made attachment (see Fig. 4) bolted to the forge cap.

Colonial steel was used, having the following analysis: Carbon, 0.88%; manganese, 0.35%; phosphorus, 0.011%; sulphur, 0.017%; scleroscope hardness, 0.44.

The blacksmith stands on the sharpener side of the double-deck stand shown in Fig. 3, with his helper on the opposite side. The smith takes a heated steel from the forge, and one step backward places him in position to operate the sharpener. The dressing of a bit requires about 30 sec.; however, the writer has often witnessed the completion of this operation in 20 sec. Much valuable time is saved by placing the finished bit on the lower deck of the double-decked stand, instead of following the old haphazard way of throwing it on the ground, where it will be in the way and must be picked up later.

The writer is very well aware of the efficacy of an intermediate or refining heat to remove forging strains, previous to tempering, but owing to the heavy steel demand and the fact that satisfactory results were obtained with two heats, it was decided to dispense with the refining heat. Two methods of tempering were practiced: One was to lower the temperature by partly quenching and then drawing the temper to the desired color; the other method consisted of plunging the bits in a brine of sal ammoniac, saltpeter and bromide of potash solution covered with about 6 in. of Houghton's No. 2 soluble quenching oil, the bit not being withdrawn until thoroughly cooled.

FIGS. 1 AND 2. DULL-STEEL RACK AND THE DOUBLE-DECK STAND

It is well known that brine as a tempering agent causes much faster contraction of the molecules than water, which contraction sometimes has a disastrous effect on the bit when drilling in lime rock; however, this rapid contraction was somewhat retarded by a protecting film of oil. The bromide of potash offset the injurious effects resulting from overheating. The other ingredients of the solution were added to soften and purify the water.

After the steels were cool, they were removed from the tempering tank and placed on the adjacent sharp-steel rack with shanks in the direction of the grinder near the shop door.

The final operation consists in grinding the ends of shanks perfectly true and square. This work is done by a No. 2 Willey direct-connected bench grinder (James Clark, Jr., Electric Co., Louisville, Ky.) equipped with 12-in. wheels. After grinding, the steels are replaced on the sharp-steel rack, whence they are carried to the collar of the Champion shaft.

*Engineer, American Zinc, Lead and Smelting Co., Granby, Mo.

Any mine operator who has ever tried to sharpen steels for two or more mines in one blacksmith shop will appreciate that it will be a matter of only a few days before one mine will have absorbed most of the steel, unless some steps are taken to prevent it. In order to provide against this, three double racks were erected along one side of the building. One of each of these sets of racks is open to receive the dull steel when it is brought from its respective mine. The other rack is protected by a wooden grating furnished with hinges and a lock. These locked compartments contain the sharp steel. A sufficient amount of steel is provided for each mine so that when a load of dull steel is delivered to the shop, it is counted and an equal amount of sharp steel is taken from the closed rack and returned to the mine, after which the dull steel is sharpened and placed in the closed rack under lock and key, awaiting the next day's demand. It can be readily seen that if the above system is religiously observed by the blacksmith it will be easily possible to keep the exact cost of steel sharpening for each mine, likewise the relative steel consumption.

The oil is stored in a pressure tank outside the building and is heated to the proper temperature by means of a coil placed in a stove, water being supplied to this coil from the mine-pump discharge column, and circulated through a hot-water jacket around the oil tank, thence

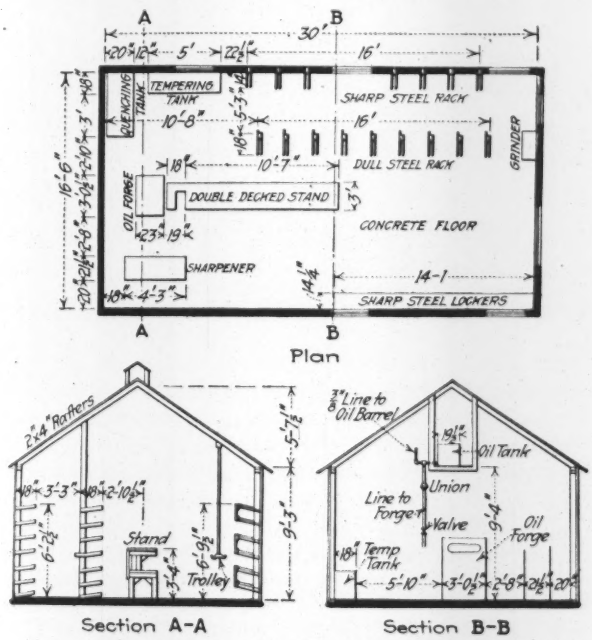


FIG. 3. DETAILS OF THE DRILL-SHARPENING SHOP AT WISCONSIN ZINC MINES

to the upper barrel, in which an oil reservoir tank is placed. In this manner a storage of about 50 gal. of warm oil is constantly provided.

Another kink consists of a trolley for supporting the drill-steel in the sharpener. A rail similar to a barn-door hanger is attached to the roof framing and carries two roller-bearing wheels in tandem, with a hanger between them from which is suspended a rod about 9 ft. long. The end of this rod is threaded to hold a double-swivel hanger (see Fig. 3), which can be adjusted instantly as to height. On this the drill-steel rests during the sharpening operation. Longer or shorter steels can be handled

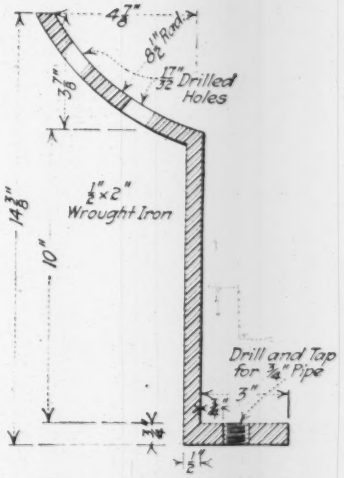


FIG. 4. ATTACHMENT OF PYROMETER TO FORGE

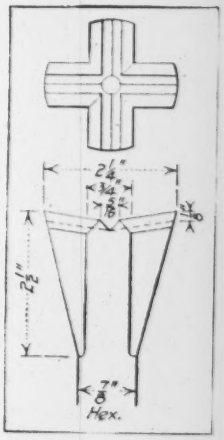


FIG. 5. DETAILS OF DOUBLE CROSSBIT

by running the trolley along its track. This eliminates the cumbersome tripod-steel support.

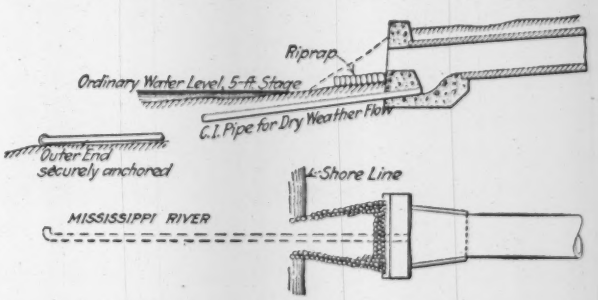
The type of drill bit used is shown in Fig. 5. It is the best bit for drilling Wisconsin limestone, when used in hammer drills, on account of its high penetrating qualities and ease of rotation.

An estimate of the total cost of this shop, with complete equipment including building, is approximately $2,300.

The writer is greatly indebted to Douglas C. Corner, former Superintendent of the Champion mine (now a member of the engineering staff of the American Zinc, Lead and Smelting Co., Granby, Mo.) for his kind assistance in preparing this article.

River Outlet for Combined Sewers

In connection with a recently published report on sewerage improvements at Davenport, Iowa, John W. Alvord, consulting engineer, Chicago, submitted a sketch for typical outlets to the Mississippi River, reproduced herewith. The general scheme is sewage disposal by dilution. Where the inverts of the mouths of the various outlet sewers would



PROPOSED RIVER OUTLET FOR SEWAGE DISPOSAL BY DILUTION AT DAVENPORT, IOWA

be above ordinary water level a run of cast-iron pipe would take the dry-weather sewage to a submerged outlet Where submerged dry-weather flow outlets are impracticable, vertical bar screens might be installed in the future; but these are to be avoided where and as long as possible on account of the trouble and expense of cleaning the screens. It is thought that complete disposal by dilution will be practicable at most of the outlets.

Cleveland's New Water-Intake Tunnel Under Lake Erie Completed

SYNOPSIS—A large part of the cost of soft-ground tunnels driven by the hydraulic shield method is due to the cast-iron lining usually employed. The new water-intake tunnel under Lake Erie at Cleveland, Ohio, is lined with cast concrete blocks at a great saving in expense. The tunnel is also notable for its rapid advance, for the disastrous gas explosion which occurred in it and for its erratic course.

A three-mile subaqueous tunnel driven by hydraulic shield and lined with concrete blocks has just been completed at Cleveland, Ohio. It is the new West Side water-intake tunnel under Lake Erie. Original methods of construction give it a place of first importance among recent soft-ground tunnels.

Notable speed of advance was recorded—a maximum of 886 ft. in one heading in a month. The soil is a stiff clay, free from risk of runs. However, marsh gas occluded in thin sand seams of the clay made the tunneling as hazardous as coal mining and, after a great gas explosion occurred in one heading, led to the adoption of regular coal-mine precautions, with the help of the United States Bureau of Mines.

By far the longest continuous compressed-air section ever employed was carried in the land heading—it attained a final length of 14,000 ft. Just as remarkable a novelty is the erratic course of the tunnel. Owing to difficulty in controlling the direction of the shield, and also to an inadequate survey force, the line departed by as much as 180 ft. from its intended course, and from the intended grade line by 6 ft. above and below.

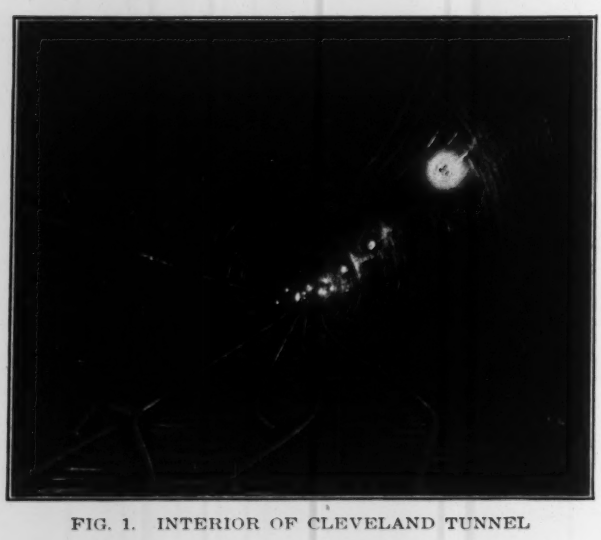


FIG. 1. INTERIOR OF CLEVELAND TUNNEL

An account of the construction in its early stages, with map of route, drawings of block erector and other details, was printed in *Engineering News* of Jan. 7, 1915, pp. 4-8.

The concrete blocks then described were used for only a small part of the tunnel, however. After the first 2,500 ft., a new type of block lining, designed by the engineers of the Cleveland Water Department, was adopted, and this "city block" was used exclusively thereafter.

The tunnel is 10 ft. in inside diameter, 16,088 ft. long, and lies at a depth of 100 to 110 ft. below lake level. The grade falls about 10 ft. from the starting point at the old Crib 4 to the new intake, Crib 5. The water depth ranges from 40 to 52 ft., leaving a roof 50 to 70 ft. thick between the tunnel and the lake bottom. The soil is nearly all clay, from lake bottom down to depths of at least 130 ft. It lies in distinct beds up to 15 ft. in thickness, and occasionally has sand seams or is apparently mixed with sand.

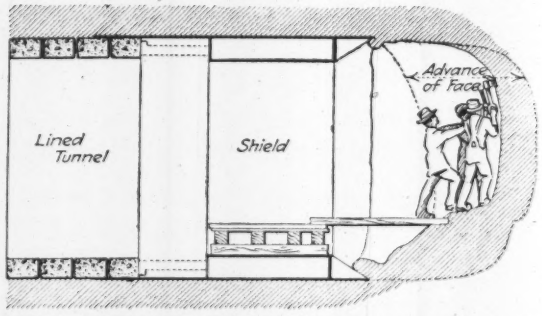


FIG. 2. PROCEDURE IN EXCAVATING AT TUNNEL FACE

In a few of the twenty or more exploration borings, traces of gas were encountered in thin strata lying at depths of 85 to 105 ft.

The broad conclusion from these borings was that at a depth of 100 ft. or so a good, stiff clay would be found throughout the proposed tunnel. This depth, which is practically the same as that of the two smaller tunnels (5 and 7 ft.) driven many years ago from the shore to Crib 4, a distance of 1½ mi., was adopted for the new tunnel, which was to extend 3 mi. out under the lake from Crib 4.

As stated in the article referred to, the clay in question is water-tight, and so stiff that free-air excavation in it is quite feasible; and although the tunnel was started with compressed air "as a precautionary measure," yet it was hoped that "as it progresses it will be possible to take the pressure off." In spite of this hope it was found impossible, and the work was done with compressed air throughout; 20-lb. pressure was carried on the average.

At Sta. 40, in the land heading, a trial was made of working in free air. It was continued for three weeks, and then compressed air was resumed. Superintendent Van Duzen said the compressed air tended to hold the ground in the heading excavation and provided easy drainage of the shield water by means of the blowpipe; in free-air working, a pump had to be set up to remove the incoming water.

While the clay is stiff, holding so well that the unbalanced inward pressure of nearly 30 lb. per sq.in. did not prevent leaving the face open and unprotected during the idle Sundays, yet it is cut through by innumerable jointing planes. There are two series of these joints, with strike about northeast-southwest and with dip about 60° westward and 30° eastward respectively. The clay face always tended to squeeze in, very slowly, by sliding on these joints.

The shield is a simple riveted-steel double-ring structure, without interior partitions or diaphragm. It has a cast-steel cutting edge of the usual type, but no hood. Its total length is 15 ft. 1 in., its diameter 12 ft. 2⅛ in.; these proportions made it rather hard to guide. It is driven forward by 12 jacks with 9-in. plungers—some of the identical jacks used in the shields of the Hudson River tunnels of the Pennsylvania R.R. at New York ten years ago. Jack pressures of 1,500 to 3,000 lb. per sq.in. were required during the progress of the work. The higher figure represents high shield resistance, but it is partly explained by the fact that the upper three jacks were usually out of service, owing to inability to set the closing block of the ring (no reverse-taper key block being provided).

The original plan of working was to do all the excavating with a rotary cutting machine built into the front of the shield. This machine and its use were illustrated in *Enginering News* of Nov. 5, 1914, and Jan. 7, 1915. The machine continued in use in the land heading for about half the length of the tunnel. It was removed in December, 1915, and the rest of the work was done by hand excavation.

The immediate reason given for abandoning the machine was a change in the nature of the ground. Subsequent experience showed, however, that hand excavation

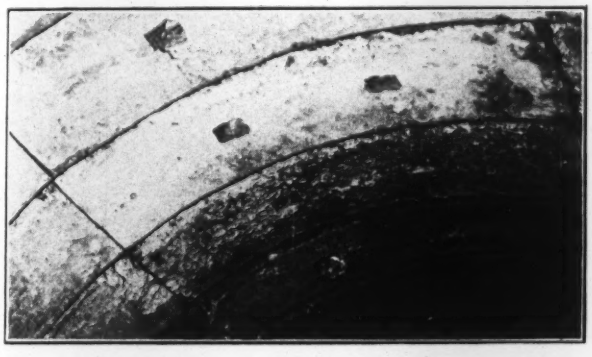


FIG. 3. CONCRETE BLOCKS IN PLACE IN TUNNEL

gave nearly as rapid progress with the same number of men, was free from liability to interruption, avoided the use of electric motors at the face and saved the operating cost of the machine.

Hand excavation was done with clay knives—semicircular drawknives fitted with 15-in. spade handles, as illustrated in *Engineering News*, Aug. 24, 1916. It was done in two lifts. The upper half of the face was first cut ahead, the men working on a scaffold of a few planks supported at the rear by a permanent platform built in the shield ring, and at the front by gains cut in the clay face. The entire distance of advance of the shift, up to three or four rings of blocks (4½ to 6 ft.), was excavated in the upper half. Then the planks were removed and the lower half was excavated. When the advance exceeded three rings (it reached eight rings per shift), one-half was excavated and the corresponding rings were set, and then the second half of the advance was cut out.

The regular heading gang consisted of 8 to 12 men, four working in the face (three cutting and one passing the pigs of clay back to the shield platform), and the others passing clay from the shield platform to muck cars and handling the cars.

In the block lining resides one of the main innovations adopted by the engineers of this tunnel. The blocks were used as a substitute for the brick lining of the earlier intake tunnels at Cleveland.[1] Ordinarily, cast-iron segmental lining is used when the shield method of advance

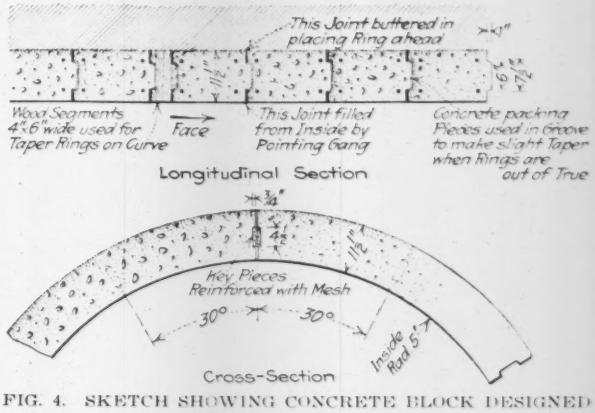

This Joint buttered in placing Ring ahead
Wood Segments 4"x6" wide used for Taper Rings on Curve
Face
This Joint filled from Inside by Pointing Gang
Concrete packing Pieces used in Groove to make slight Taper when Rings are out of True
Longitudinal Section
Key Pieces Reinforced with Mesh
30°
30°
Inside Rod 5"
Cross-Section

FIG. 4. SKETCH SHOWING CONCRETE BLOCK DESIGNED BY CITY'S ENGINEERS

is adopted, but the high cost of cast-iron lining made some other solution desirable in this case.

Various patented concrete blocks were considered, and the Parmley block was used for 2,500 ft. of the land heading. The city's design was then adopted, however, and was used for the rest of the work. It was laid with rings breaking joints (Fig. 4), whereas the Parmley block was laid with continuous longitudinal joints. The delay and inconvenience of placing reinforcement in the ring joints were factors in changing over to the city design of block.

The lining is 11½ in. thick and each ring is 18 in. long. Other dimensions are given in Fig. 4. There are six blocks to the ring, all alike. No taper rings were molded, but filler pieces were used to make the slight adjustments required on account of the blocks building longer on one side or on top.

As the blocks are equal, the sixth block of a ring can not be placed until the shield has advanced another shove. For this reason, generally, the upper jacks of the shield were not used, which resulted in less compression of the lining at the top and therefore a tendency of the

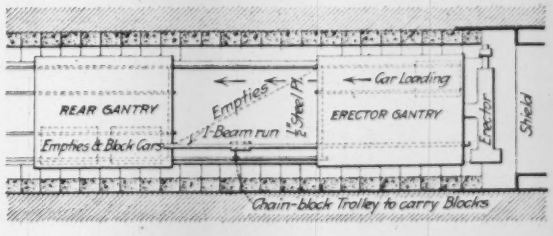


FIG. 5. SECTION SHOWING ARRANGEMENTS FOR HANDLING MATERIALS AT TUNNEL FACE

rings to lean forward successively more. In some parts of the work, it was therefore necessary to insert 2- to 4-in. fillers at the bottom about every 50 ft. In the crib heading, a temporary wooden key block was generally placed to get the use of all the jacks. This was replaced by a concrete block as soon as the next shove was made.

[1]These include a 5-ft. tunnel 6,600 ft. long completed in 1874; a 7-ft. tunnel of the same length built in 1888-'90; and a 9-ft. tunnel 5 mi. long completed in 1903.

A pointing gang worked 100 ft. or more back from the shield, filling all joints showing on the inside and producing a smooth, finished surface. The invert was pointed-up in some cases by a separate gang working well back of the first. This second gang cleaned the bottom (under the track) and pointed-up, leaving the tunnel in a practically finished condition.

The high jack pressure often required in shoving the shield produced a certain amount of splitting and spalling of the blocks. When spalling occurred, it was generally at the rear edge of the leading ring, where the raised

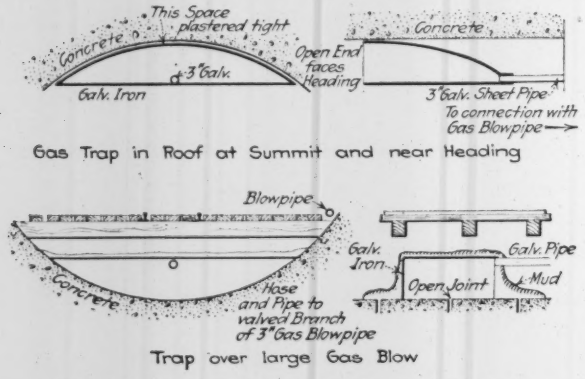


FIG. 6. ARRANGEMENTS FOR DRAWING GAS FROM TUNNEL

borders of the ring-joint mortise tended to spall away. Sometimes unequal bedding of the leading block against the two blocks back of it led to transverse cracking or breaking of the block against which the jack bore. Not many of these cases were considered serious enough to require cutting out the cracked block. In such cases, however, the work was done at some point back in the tunnel rather than stop the heading progress to replace the block at once.

Handling Blocks and Muck

Handling the blocks into place in the ring was done by a pneumatic erector, a jack pivoted at the front of a gantry frame dragged along by the shield. The erector was illustrated in *Engineering News*, Jan. 7, 1915.

About 14 ft. back of the erector gantry was a second gantry frame, for unloading the blocks from cars, as the

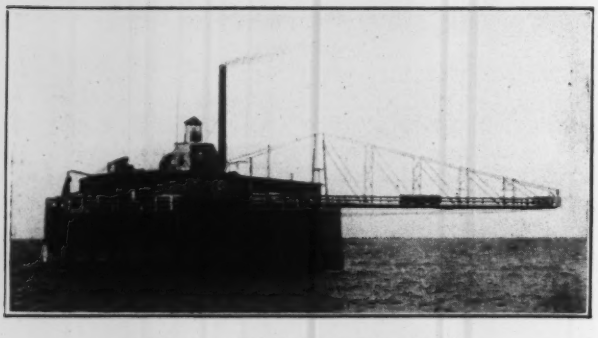


FIG. 7. VIEW OF LAKE CRIB

erector gantry was too low for running these cars through. An I-beam runway extended forward from the top of the rear gantry, under the erector gantry to its forward end; a chain-block trolley running on the I-beam lifted a block from the car (two blocks were loaded on a flat-car, one on top of the other) and skidded it forward to a position under the erector.

Muck cars were loaded under the erector gantry on the side opposite the block runway. A steel plate placed in the space between the two gantries, between the outer rails of the two tracks, allowed cars to be transferred from the right-hand empty track to the left-hand loading track and yet allowed loaded cars to be run straight back on the track for outgoing full cars.

The two gantries and the plate between, together with tracks, were hitched together and to the shield, so that they were dragged forward as the shield was shoved, and kept all parts in proper relation.

A single track was laid in the tunnel, with passing sidings at intervals. Haulage was done by compressed-air locomotives in the long air section of the land heading, and by a gasoline locomotive in the 7,000-ft. free-air approach through the old 7-ft. tunnel. Charging stations for the compressed-air locomotives were placed at ½-mi. intervals.

In the crib heading, a 300-ft. hauling rope pulled by electric hoist was used to overcome an upgrade against

FIG. 8. SANDY SEAM IN CLAY, CRIB HEADING

loaded cars; but after the complete banishing of electric equipment from the compressed-air sections because of explosion danger, the cars were pushed by hand.

The work throughout was run in three shifts of 7 to 8 hr. each, but only the day shift carried pointing and cleaning gangs. The rate of pay for compressed-air work was $4.50 during the larger part of the work. There was no Sunday work.

Marsh-Gas Difficulties

The common occurrence of marsh gas in the Cleveland clay was known before the tunnel was started, and some of the exploration holes had encountered traces of gas. The explosion danger was therefore well known. From the beginning, open lights, matches and similar sources of ignition were barred, and these precautions were enforced more strictly as the work proceeded and an occasional inflow of gas was found.

The gas occurred in an erratic manner. Often the seepage was strong enough to make a blowing noise. If in the invert, it would bubble up through the slight amount of shield drainage that collected at the cutting edge in the bottom of the face.

The biggest inflow was struck in the crib heading by the afternoon shift on Saturday, July 22, 1916. The workmen on the night shift at the face were so much bothered by the quantity of gas (which reduced the oxygen by dilution, the marsh gas having no directly poisonous effect) that they had to stop work after a few hours. An 8-ft. summit in the tunnel about halfway out, 650 ft. from the airlock, made it difficult to get in or out, as the gas pocketed at the summit; yet the shift got out safely.

The Great Explosion

An air vent was placed in the low-pressure compressed-air line at the summit the next day (Sunday), during which, as usual, work was suspended. No shifts went in on Monday, but work was to be resumed at midnight Monday. The shift went in at 8 p.m., so as to get through

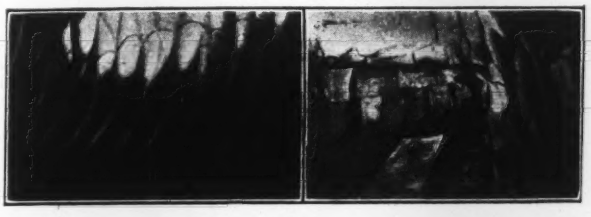


FIG. 9. SLIP SEAM IN CLAY FACE, AND USE OF KICKING STRUT TO TURN SHIELD (LAND HEADING)

earlier because of survey work which the acting foreman—S. H. Vokes, a civil engineer in charge of the survey work in both headings—had to do the next day.

About an hour later the air-pressure gage in the engine room was reported to be erratic, having jumped to 30 lb. suddenly and then gone back. The superintendent went down and found the lock closed, and the lock tender inside the tunnel trying to open the inner door. Some time later this man released the door and got out, with the report that something had happened.

Two rescue gangs that went in were overcome; nearly every man in each died. The leader of the second gang reached the summit, and lay there, kept alive by the air vent, for four or five hours before a party with smoke helmets brought him back.

A rescue party from the Pittsburgh Bureau of Mines station arrived half a day later and took charge of rescue and safety arrangements.

The something that had happened in the tunnel was a great gas explosion in the forward half, probably extending from the face some 800 ft. back to the summit. It blew out half a dozen large sections of roof, and through these holes the tunnel was filled solid with muck for 290 ft. It killed all the men where they stood. The hoist at the summit was blown 15 ft. back. Ties were bunched solid, 25 in a group, sheared out from the rail spikes. Ties far back near the airlock were broken downward. Near the summit, cable-hanger hooks were bent backward.

Most of the roof-arch blocks blown out by the explosion fell into the tunnel. A few blocks, however, were never recovered. They probably were forced out into the surrounding clay.

Closing the holes in the lining was done by digging away the clay enough to allow placing timbers outside, supported on the lining at either end of the break. The holes were bricked up, on inside centering, while clearing of muck advanced.

The coal-mine men sent by the United States Bureau of Mines, headed by W. J. German, stopped the replacement of electric-light wires which was in progress the day after the explosion, and thereafter banished all electric circuits and motors from the tunnel. The erector-traversing motor, which is thought to have furnished the spark for the explosion, was replaced by a chain-geared air motor. Storage-battery headlights were provided for general illumination at the working points, and storage-battery cap lights were furnished to the men. The only electric circuit allowed was a single telephone line from shafthouse to heading. At times of especially heavy gas flow even this was disconnected.

Coal-Mining Safety Precautions

Tests of the tunnel air were instituted. Samples from points near the gas "blowers" and from various other selected points were taken at the start. These showed alarmingly high percentages at some points; as much as 17% was found at the face, before resumption of driving. When no gas traps had yet been put in, a large part of the tunnel was at times filled with a gas mixture of explosive proportion (4 to 12%), producing conditions which were in the highest degree dangerous. Constant inspection by safety lamps was therefore instituted, firebosses being secured from the Pittsburgh coal-mine region, so that there was a man on duty every shift. Vacuum-tube samples of the tunnel air were taken weekly and sent to the Pittsburgh station of the Bureau of Mines for analysis. The gas was found to be pure methane (CH_4).

Gas traps were placed to catch the larger part of the gas before it could diffuse through the tunnel. These are sketched in Fig. 6. The main trap over the blower that was responsible for the explosion is an inverted pan of sheet iron placed under the track and piped to the

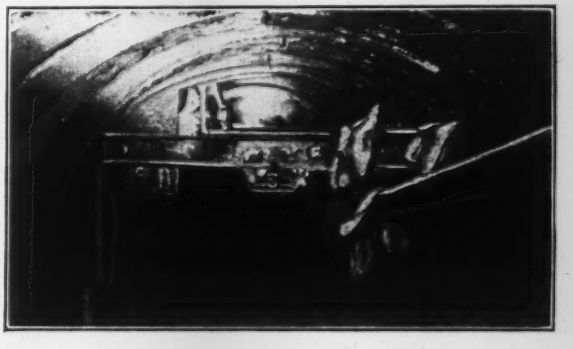


FIG. 10. VIEW IN CRIB HEADING, SHOWING ROOF

blow line by 3-in. hose. The lining joint nearest the blower was left open, while the other joints were calked and pointed-up tight. This arrangement succeeded in bringing practically all the flow to the trap.

Two roof traps were placed in the crib heading, and one in the land heading, at 200 to 400 ft. back of the face. These are sheet-iron funnels fitting the upper segment of the arch curve, facing toward the heading and piped at the smaller rear end to the blow line. As the air movement in the tunnel is backward toward the lock—the low-pressure supply line discharges near the face—the gas is carried toward the trap and is drawn off by the suction.

The importance of these precautions was made evident at every test. By shutting off the plug-cock in the tee

where the trap hose connected to the blowpipe, and thus stopping the suction at the trap, the floor trap sent gas enough into the tunnel to produce an explosive mixture several feet away (as shown by safety-lamp test) within a minute or two.

Estimates of the rate of gas inflow at the main blower of the crib heading indicated that, when not trapped, it filled half the length of the crib heading with an explosive mixture in the upper half of the tunnel in one hour.

Clearing the Shield by Water Jets

The north shield (crib heading) was found to have an abnormally high jacking resistance when work was resumed after the explosion. Soon it was noticed also that the new lining placed back of the shield tended to spread several inches, as soon as the tail of the shield moved off it. The shield evidently was dragging along a rough skin of caked material that resulted in leaving excessive voids behind the shield.

Indications of similar trouble having appeared in the driving, the conclusion was reached that some grout had adhered to the shell of the shield at the time of starting from the shaft, when a little grouting had been done. This skin of grout, apparently, caught some of the surrounding clay during the long stoppage of the shield after the explosion, and dragged this clay along.

To cure the trouble, the crib superintendent, J. R. Johnston, led three ¾-in. jet pipes forward to the cutting edge and, bending them around the edge, shoved them back 5 or 6 ft. Two of these were at the horizontal center line and one at the bottom. By forcing water at high pressure through the pipes just before the shove, it was hoped to lubricate the skin of the shield and prevent adhesion of clay. The scheme succeeded. The trouble with spreading of the lining disappeared.

Similar trouble, of lesser degree, in the land heading resulted in the jet-pipe system being adopted here also. It proved particularly useful in helping to swing the shield around a sharp curve which was necessary to bring the two headings to junction.

Serious Faults in Alignment; 180-Ft. Divergence

The tunnel was rather irregular in its course from the start, both in grade and in line. The land heading diverged laterally from true line in the first two or three thousand feet by amounts of several feet to one side and the other. In grade it was not quite so erratic at first, but before Sta. 40 was reached it dipped down 4 or 5 ft. below grade.

The initial troubles were caused by the heading foremen's inability to control the shoving of the shield. The irregularity of the forward face of the lining blocks—which afforded no such definite plane as the machined face of a cast-iron lining ring—was a factor in this.

Further, the blocks crowded back a little as the jack pressure was applied, and sometimes they spalled or cracked, as already mentioned. The fact that the shield is longer than its diameter, and the inability to use the upper jacks because of omission of the key block of the last ring, contributed toward making the shield hard to manage.

Worse divergences started before the end of the first mile. Beginning about Sta. 45, the tunnel took an irregular course, bearing off to the east of true alignment, diverging more or less in ratio of distance, until at Sta. 66 it was about 170 ft. off line. Thence to Sta. 86 its course was roughly parallel to the true line (at about 170 ft. distance). In the next half mile it made partial recovery, getting back to within about 100 ft. of its intended location. Its course then ranged between 110 and 135 ft. off the true line.

The grade of the tunnel is also irregular, but much less so than the alignment. The lowest and highest points are about 6 ft. below and above the intended grade, and in place of the intended very flat drainage gradient toward the outer end of the tunnel (to bring any entrained air to the pumping station) there is a reverse grade on some sections. The maximum slope is nearly 1% up, in the outward direction, and this prevails on a length of about 600 ft.

These great divergences of the tunnel are in part explained by the statement that for many months the men at the shield had no alignment marks set for them within 1,000 ft. of the face. There was only a single survey engineer for the tunnel, and he had to work most of the time with no assistance beyond that of a borrowed tunnel workman. The survey work was done under the hampering conditions of an unusually long compressed-air section, where the atmosphere often was badly fogged by the discharge of the compressed-air locomotives.

Proof that lack of alignment marks near the face had much to do with the divergence from line is found in a comparison of the conditions as to line and grade. A simple device for checking the downward or upward inclination of the shield was provided, in the form of a carpenter's level hung longitudinally in the shield. The heading foreman could read the level at all times, before and after the shove, and thus knew whether he was headed up or down. With respect to line, on the contrary, there was no guidance whatever. Through a large part of the construction no sighting points were set in the tunnel, and no sighting line was provided in the shield by which its direction of pointing could have been judged if there had been center-line marks within sighting distance.

The crib heading experienced divergences somewhat similar to those of the land heading, but much smaller. Laterally it remained fairly straight; its grade conditions were bad. A summit of about 8-ft. height occurs near Sta. 6 + 50, and in the next four or five hundred feet the tunnel goes down again nearly to true grade line.

When the two headings approached within about 1,500 ft. of junction, a new set of careful surveys was made by E. Statham, an experienced tunnel-survey engineer. With the data thus obtained, the positions of the two headings were computed and a reverse-curve course was laid out to bring them to junction. A grade of some 3½% was required on this course, the land heading descending and the crib head ascending to the junction.

That the shields could be managed with a high degree of precision was demonstrated when the headings swung around the curves (of about 180-ft. radius). The shield of the crib heading was brought around this curve excellently, with no other means than the jacks and jetting pipes. In the land heading, however, it was thought necessary to use a kicking strut, a 12x12-in. timber from the cutting edge at the inside of the curve to an abutment placed against the opposite side of the face excavation.

The headings were holed through on Dec. 14, 1916, and the shields brought together later.

The tunnel was designed and its construction begun under C. F. Schulz, Commissioner of Water, assisted by C. P. Jaeger, Deputy Commissioner. Mr. Schulz resigned early in 1916, when over half the length of the tunnel had been driven, and Mr. Jaeger was in full charge until he in turn resigned, in September. The tunnel was completed under the administration of G. B. Dusinberre, Commissioner, and J. T. Martin, Deputy Commissioner. Throughout the work, G. C. Van Duzen was Superintendent.

The tunnel was originally estimated to cost about $900,000, and because this was some 12% below the lowest bid obtained from a contractor, the city undertook the work by its own labor. The actual cost of construction is known to exceed the advance estimate considerably, but no figures are available.

Ruin and Recovery of Saratoga Mineral Springs

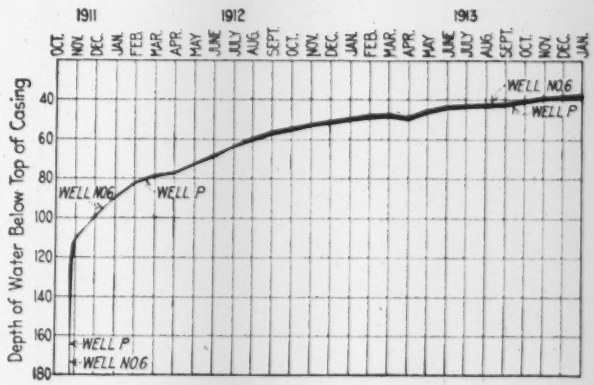
By Charles G. Anthony*

Far back in the early ages of geologic time a fault occurred in the complicated strata of rocks and other deposits overlying the original gneiss on the site of what now is Saratoga, N. Y. Along the line of this fault, which runs generally northeast and southwest with a trend to the west, the rocks on the westerly side of the crack were displaced from their counterparts on the easterly side for a distance of approximately 250 ft. Through this break in the layers of the earth's surface the waters of the springs of Saratoga first reached the surface. Along this fault and on its east side every known spring of the Saratoga system is now to be found. Many deep wells were drilled on the west side of the fault, but only soft pure water was found, while only a few feet across the fault on the east side the drill always releases highly carbonated mineral water. Many such mineral wells have been drilled, and at the present time all the springs and bores, about 150 in number, are found in a narrow belt about 2,000 ft. wide paralleling the fault for a distance of 4½ mi.

About 20 years ago a company located at Saratoga and started to separate the carbonic acid gas from the water, liquefy it and place it on the market in 20- and 50-lb. tubes. The gas business was highly profitable. Other gas companies located at Saratoga. The natural flow from the springs and wells could not satisfy the demand; deep-well pumps were installed, and for a period of 15 years they were operated day and night. One company pumped 290,000 gal. of water daily. There were five companies operating. Springs that, from the earliest times of their uncertain tradition, had been bubbling and effervescing ceased to flow. Springs that spouted jets of water 50 ft. into the air died out, and the orifices became dry holes crowned with cones of tufa. As the mineral-water level receded, the pump barrels were lowered deeper and deeper until at the end of 20 years the commercial bandits had ravished one of nature's most wonderful laboratories, so slowly constructed through the ages of layer upon layer of rock deposit.

The extent of the depletion was exactly determined five years ago after the State of New York by condemnation took possession of the 640 acres of property. In October, 1911, all pumping was stopped by the state. The gas plants were dismantled, and several men were employed to measure the water levels in the well. For the first few days after pumping stopped, the measurements were taken hourly; later on they were taken daily, and finally as the rise became less pronounced the readings were taken once a week. Curves showing the rise in water level were plotted for each of the 110 wells. All the curves are of the same character, so only two are reproduced here. These two wells, *P* and No. 6, are 1½ mi. apart and are separated by the deep valley of Coesa Creek.

The chart shows that at the time the pump barrels were drawn, in October, 1911, the water level was 182 ft. below



RISE IN WATER LEVEL OF TWO SARATOGA WELLS AFTER PUMPING WAS STOPPED

the top of the casing. Both of these wells when first drilled flowed naturally at the mouth of a 6-in. casing. There has been no change in the water level since January, 1914, showing that, 2.2 years after pumping stopped, the water reached its maximum elevation. The ratio of gas to water is not now as great as it was when pumping started 20 years ago, or these two wells would now be flowing. The mineral content of a few of the springs was so depleted that at the present rate of change these springs will not reach their normal mineral content for 25 to 30 years, and as a paradox some of the springs are now higher in mineral than when pumping started.

Obtaining Potash from Seaweed in the Sargasso Sea is a project which is to be undertaken by W. S. Warner of Tampa, Fla. Mr. Warner was formerly a sea captain, and has also done work in the development of the Florida phosphate deposits. He plans to build an 8,000-ton vessel of reinforced concrete, 300 ft. in length, 50 ft. beam, and 24 ft. depth of hold. The vessel is to be subdivided by bulkheads into water-tight compartments, and is to be equipped with machinery for hoisting the seaweed from the ocean and reducing it to ashes. As the seaweed is raised from the water, it will be run through three successive sets of heavy rolls which will remove 85% of the surplus water which it contains. After passing through rotary drying kilns, the seaweed will be burned and the ashes, in which the potash content is concentrated, will be discharged into the hold of the vessel. The equipment is planned to be capable of hoisting, drying and burning enough seaweed to produce 200 tons of ashes per day. Captain Warner claims that the Sargasso Sea is a region of such continuous calm, with freedom from both wind and wave, that the work can be carried on continuously without interruption, and there will be no difficulty in transferring the accumulated ashes from the seaweed-gathering barge to the steamers which will visit it regularly to transport the ashes to shore. The amount of seaweed in the Sargasso Sea is so vast as to be beyond estimation. Steamers, however, can navigate the sea and the patches of seaweed in it are not continuous.

*Chief Engineer, State Reservation, Saratoga Springs, N. Y.

Rock-Fill Dam Has Timber Face

By Kenneth A. Heron*

A low rock-filled dam in which the upstream face is well protected by a heavy planking has recently been constructed on the Goose Lake Valley Irrigation System in Oregon.

The principal source of water for the system is Drews Creek, which has a drainage area of 211 sq.mi. of mountain country west of the valley. The months of heaviest stream discharge are April and May, which in this locality are before the irrigation season. After the middle of the latter month in normal years the flow is very little. To conserve the entire stream discharge for irrigation and power purposes a large rock-fill dam has been constructed in a narrow cañon on the creek about 8 mi. above its outlet into Goose Lake. The dam consists of a rock fill 65 ft. high, with downstream slope of 1 on 1½, a 10-ft. crown and a reservoir side sloping at 2 on 1. It will impound 62,000 acre-feet and backs water up Drews Creek 8 mi. The main portion of the fill consists of only the larger rock from the hillside quarries (Fig. 3). In finishing the fill, however, all the material from the borrow pits was used. The reservoir side of the fill is hand-placed dry wall 5 ft. thick at the crown and having its back slope 3 on 1. On top of this is a double-thickness plank facing tied to the bedrock in the creek bottom and sides with a masonry and concrete cutoff wall. This cutoff was placed in such a manner that, if at any time in the future it is desired to replace the timber face with a reinforced-concrete face, it can be done without any material alteration in the present construction except removing the timber face. At the time this work was done a concrete face was considered, but the use of concrete on any large scale was prohibited on account of the fact that the nearest railroad point was 65 mi. from the dam site. It is probably just as well that the timber face was placed instead of a concrete one, as it is serving its purpose very well and also because some settlement has taken place in the fill, which might have caused openings in a face of concrete, but has not harmed the more elastic timber face. On the upstream side of the cutoff wall in the creek bottom an earth-fill was placed to insure against any seepage at that point.

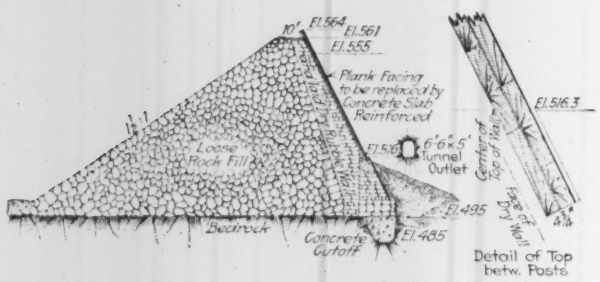


FIG. 1. SECTION THROUGH DREW'S DAM, GOOSE LAKE VALLEY IRRIGATION DISTRICT IN OREGON

A spillway 120 ft. wide, with its lip 9 ft. below the crest of the dam, was excavated through the solid rock on the north side of the dam.

The main reservoir outlet consists of an unlined tunnel through the cañon wall around the south end of the fill. Two 2x5-ft. Coffin gates set in a shaft near the upper end of the tunnel form the principal control works. A smaller outlet designed for power purposes, a 36-in. steel pipe, is embedded in concrete and masonry through the center of the dam. A 36-in. sluice gate on the upper end of the pipe controls the flow.

FIG. 2. UPSTREAM PLANK FACING TO DREW'S ROCK-FILL DAM

FIG. 3. VIEW SHOWING RELATIVE SIZE OF ROCK IN LOWER PART OF DREW'S DAM

*Chief Engineer, Goose Lake Valley Irrigation Co., Lakeview, Ore.

Refitting an Oil-Burning Ship for Coal is not an immensely difficult operatio if means are provided for carrying coal fuel. The change in the boilers consists merely of removing the burners and oil piping, air-controlling mechanism and special brickwork, and substituting a few necessaries such as grate bars and fire doors. Where steam-atomizing burners are used, the grate bars and bearers are usually retained while burning oil, and merely covered with a protecting layer of firebrick. George Simpson, naval architect, presents in the note section of the "Journal" of the American Society of Naval Engineers, for November, some rules for arranging the bunkers for alternate use with either fuel. Briefly, the cross bunker is to be arranged adjacent to the fire room and is to consist of two thwartship oiltight bulkheads of predetermined capacity. There is to be a centerline oiltight bulkhead dividing the cross bunker into port and starboard compartments, and in addition there should be partial swash bulkheads extending throughout the upper half of the bunker.

Nonfireproof Institutional Buildings in New York City Made Safe Against Fire

SYNOPSIS—Methods employed by City of New York in making safe many of the originally nonfireproof institutional buildings under the Department of Charities. Main reliance is on vertical firewalls, which in case of fire permit ready horizontal transfer of inmates to an adjacent safe section under same roof. Additional protection in the way of signals, pipe lines, chemical engines, fireproof doors and windows, etc.

With the award of the contract to the Werner-Huberty Co. on Nov. 2 for the remaining portion of the work comprising the improvements in the three groups of buildings on Blackwells Island, the Kings County

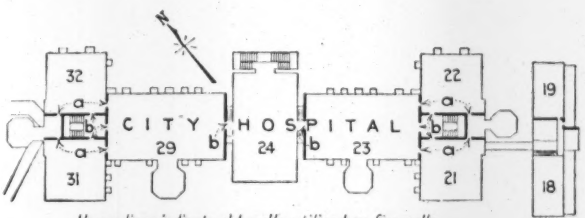


FIG. 1. PLAN OF CITY HOSPITAL BUILDING, SHOWING OLD WALLS UTILIZED AS FIREWALLS

Hospital group in Brooklyn and the isolated buildings scattered throughout the greater city, all the fire-protection work contemplated in the Department of Public Charities is now contracted for. Similar work in the buildings on Randalls Island and in the New York City Farm Colony on Staten Island was completed last year under contract with the Spuyten Duyvil Construction Co.

Inasmuch as safety to life problems are comparatively new and as these alterations are the most extensive of any such work that has thus far been undertaken, a brief history and description of them will be of interest.

Immediately after the Asch Building disaster in March, 1911, the late M. J. Drummond, then Commissioner of Charities, became solicitous for the safety of the helpless wards of the city filling the numerous nonfireproof institution buildings in his department. Upon his request a survey was promptly made by a committee that inspected 32 of the principal buildings having a large occupancy and recommended the installation of additional water mains, pumps, standpipes, hose, fire extinguishers, etc., the construction of numerous outside fireproof balconies with stairways, outside fire escapes both of the usual patterns and of the helical-chute type. The total estimated cost of the work in the 32 buildings was $149,000, and this amount was appropriated for the purpose by the city.

Before advertising for bids, however, the city engaged H. F. J. Porter and A. L. A. Himmelwright to review the findings of the committee and make a further detailed study of all the buildings under the jurisdiction of the department, numbering 206. From their report most of the following data are gleaned.

General Protection Methods Followed

The character of the buildings ranged from the recently completed fireproof buildings with incombustible floor finish, trim, etc., to temporary frame structures; but the large majority were of the nonfireproof type three to five stories high, with masonry walls, wood interiors and wood roofs covered with tin, slate, or tar and felt roofing.

The varied occupancy of the buildings—from infants to adults of both sexes, including the feeble-minded, blind, aged, and helpless hospital patients—still further complicated the fire-hazard problems. It was impossible, therefore, to follow any set rule in the treatment of the buildings; each had to be considered separately, solving the problems presented in each and taking advantage of any favorable conditions that existed. In this manner the most practical and economical treatment that would provide reasonable safety to life and protection to property was determined for each building.

In nearly all the larger buildings masonry dividing walls were found, which originally were exterior walls before wings and additions were built. Such of these walls as occupied strategic positions and could readily be developed into and be utilized as firewalls were recommended to be so converted. In this manner the danger zone from fire to both life and property in these buildings was reduced by vertical subdivision. This principle of the division of the fire hazard by utilizing existing walls or firewalls was found to be quite generally applicable and was recommended and later adopted on the grounds that it secured largely increased safety at less

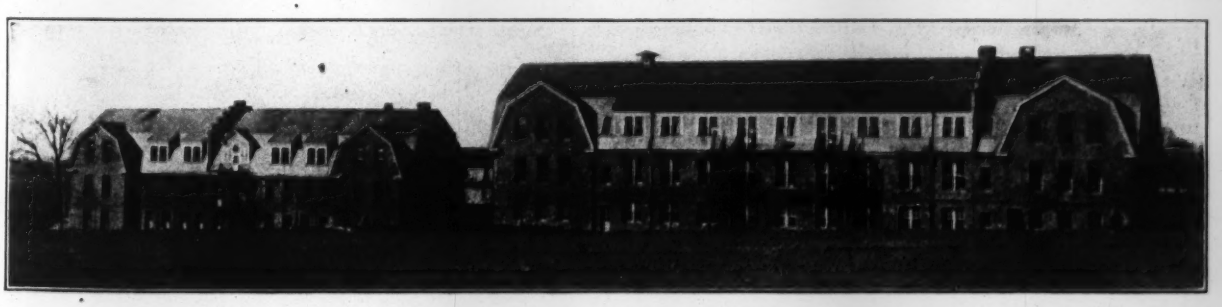


FIG. 2. TYPICAL BUILDINGS TO WHICH FIREWALLS HAVE BEEN ADDED

Buildings at New York City Farm Colony, Staten Island. In building on left new firewall, shown projecting above roof, has been built. In building on right an existing wall has been made into a firewall

cost than any other treatment that had been previously suggested.

The report also embraced a complete design for a fire-signal system for all the buildings in each group. This system was specially adapted to the character of the occupants and signaled only those who were in the danger zone and automatically called the fire-fighting forces to the fire and notified the central office.

The fire alarms that had been in use were a code of whistles blown from the boiler plant in each group. These were pronounced unsuitable and inadequate because of possible failure and always delay on account of the necessity of telephoning from the building in

FIG. 3. FIREDOORS AND HORIZONTAL EXIT, INFANTS' HOSPITAL BUILDING, RANDALLS ISLAND

which the fire occurred to the boiler plant, and the unnecessary alarm of those not in the danger zone, the excitement often injuring those who were very ill and weak and retarding their recovery.

For the groups of buildings on Randalls Island and the Farm Colony, Staten Island, which are isolated from the city fire department protection, chemical fire engines and special local fire-fighting brigades were recommended. The minor fire hazards now usually designated as housekeeping conditions were all pointed out, and the most practical manner of eliminating them was suggested in the case of each and every building.

This report was approved and adopted by the city, and Messrs. Porter and Himmelwright were engaged to prepare plans and specifications and to supervise the work of construction. The most urgent of these improvements were contracted for and completed last year, and the remainder are now in progress. A general idea of the character, location and number of the buildings embraced in this work will be given by the accompanying table. The total contract cost of the protection to 206 buildings was $117,000.

How Protection in City Hospital Is Accomplished

A very good idea of the manner in which all the buildings are being made safe can be obtained by a description of the treatment of a few that are typical.

The City Hospital, which is the main building of the City Hospital group, will be an excellent illustration of the treatment of the large hospital buildings. A small-scale floor plan is reproduced herewith (Fig. 1). The building is four stories and basement in height. It has stone walls, wood interior and a wood roof covered with slate. Its capacity is 1000 beds, and its

BUILDINGS PROTECTED AGAINST FIRE FOR THE DEPARTMENT OF PUBLIC CHARITIES, NEW YORK CITY

Group	Location	Character of Inmates*	Number of Buildings† Institutional	Service
City Hospital	Blackwells Island	General hospital and surgical	15	5
City Home	Blackwells Island	Aged, blind, neurological	23	9
Metropolitan Hospital	Blackwells Island	General hospital, surgical, tubercular	21	6
Kings County Hospital	Brooklyn	General hospital, surgical, tubuercular, aged, blind and cripples	28	7
Randalls Island	Randalls Island	Feeble-minded children	31	7
Farm Colony	Staten Island	Poor, aged, but able-bodied	14	6
Sea View Sanitarium	Staten Island	Tubercular	13	2
Cumberland St.	Brooklyn	General hospital, surgical, infants	2	1
Coney Island	Coney Island	General hospital, surgical	4	2
Isolated buildings	Greater New York	Administration buildings	8	2
			159	47

Grand total = 206

* The average population in all the groups is about 17,000. † Service buildings include boiler houses, laundries, workshops, storehouses, kitchens, bakeries, garages, stables, etc.

normal occupancy when filled with patients is from 1400 to 1500 persons, there being 400 to 500 nurses, attendants, surgeons, visitors, help, etc. A large number of the patients are bedridden and helpless. The standpipes are connected with the house water-supply system. One fire-engine company is located near the middle of the island and requires 5 min. to reach the building. Other fire-department apparatus and men from Manhattan cannot reach the building in less than 40 min. A fire in any part of the building would endanger the whole structure and annex and would jeopardize the

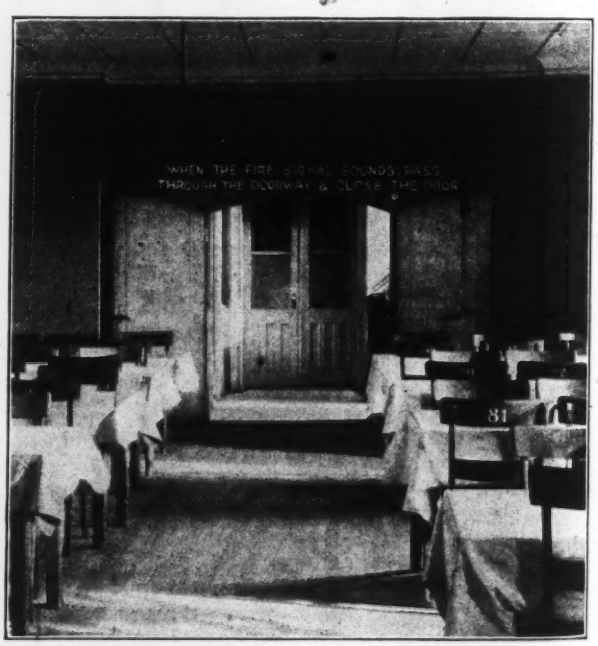


FIG. 4. HORIZONTAL EXIT THROUGH FIREWALL IN FARM COLONY BUILDING

lives of all the occupants. The fire-drill scheme proposed, in case of fire, to call all the help from the service buildings by means of a code whistle at the boiler house and attempt to extinguish the fire and empty the building of all the occupants. The possibilities of such a procedure on a stormy winter night were very discomforting to the Commissioner of Charities, but it was the best that could be done under the existing conditions.

The accompanying floor plan indicates that the building consisted of an original building 24, with two wings 23 and 29 added later, and after that two additions at each end 21, 22, and 31, 32, with an annex 18, 19 connected with the main building by a bridge at the second-floor level. The heavy dividing lines indicate existing masonry walls occupying strategic positions that are to be converted into firewalls, thus dividing the main building into seven vertical sections or fire units, as they are designated, and the annex into two additional units. Between units 21 and 22, and 31 and 32 are fireproof stair halls and stairways inclosed by 17-in. brick walls.

All the walls to be converted into firewalls are to be extended through the attics and roof and to an average height of 3½ ft. above the roof and are to be coped. The woodwork on opposite sides of these walls is thoroughly isolated. All openings in these walls, except specified doors to be used as horizontal exits and designated as *A* and *B* doors, are to be bricked in solidly the full thickness of the walls. Where there is any probability of fire spreading around the ends of these walls, one or two vertical lines of windows are fireproofed by substituting metal trim and sash and wire glass for the present windows. All wood cornices and projecting wood roofs within 5 ft. on each side of the line of the wall are to be replaced by hollow metalwork, fire-stopped along the line of the firewalls and duplicating in design and color the woodwork replaced.

All the present woodwork in the door openings in the firewalls is to be removed, including all trim, flooring, etc. The head and jambs are to be finished in hard plaster, and a concrete with a cement-finished sill is to be built up from the wall by corbeling out the wall 4 in. on each side of the opening, so this sill will extend under the firedoors in the closed position in all cases. Standard sliding Class A firedoors are specified to protect all openings in the cellars and attics, and hinged Class B standard firedoors, finished in harmony with the trim of the wards into which they open, protect the openings in the other stories.

This treatment converts the walls shown into real firewalls, making them practically as effective against the spread of a fire from one unit to another as if separated by a party wall. In other words, they divide the main building into seven separate and different buildings in so far as the fire hazard is concerned. Consequently, only about one-seventh of the occupants and one-seventh of the building can be endangered by fire at any time, no matter where it may occur. The fire hazard to both life and property in this building is therefore by this simple treatment reduced to only one-seventh of what it was formerly. Neither is it necessary by this plan to move the patients out of doors, as was formerly the case.

The horizontal-exit plan has the further advantage that the helpless and bedridden patients can be moved in their beds without discomfort or injury, that those physically able to walk or crawl may themselves reach safety without assistance or fear of injury to themselves by falling down stairways, and that when the horizontal exits are being used by the occupants the stairways, fire escapes, elevators, etc., are free and unobstructed, thus enabling the fire-fighting forces to reach the fire in the minimum time and fight it with the maximum efficiency.

In all cases at least two exits of sufficient capacity and as remote from each other as practicable are provided on each floor in each fire unit. Horizontal exits between wards through which beds are to be moved are 5 ft. 6 in. wide and 7 ft. high in the clear. Helpless patients are to be placed on beds near the horizontal exits, and these beds are fitted with special nonabrading, ball-bearing, nonswiveling casters with 3-in. diameter wheels for the head legs only. This arrangement preserves the stability of the beds the same as usual and permits the easy removal of the patient in his bed by a nurse or attendant lifting the foot of the bed and wheeling it away.

Additional Protection in City Hospital

The fire-signal system in this building is designed so as to adapt it to the improved conditions. The signals operate only in the one fire unit in which the fire occurs and in no other. Every signal is nevertheless transmitted automatically to the central office and the shops, dormitories and other service buildings, apprising them of the fire and its location and thus summoning assistance without delay. A city fire department call box is located in the central office, through which the day or night operator can instantly relay the call to the fire department. In the hospital wards the signals consist of red lights and tappers that do not alarm the patients, while in the service and administrative units the signals are single-stroke gongs of suitable sizes to fulfill the requirements. In the annex units 18 and 19 two new stairways, one on each side of the firewall, had to be introduced at each end of the building.

Numerous details required attention so as to perfect the safety scheme. In many cases water, steam and sewer pipes passed through openings in basements, cellars and attics that required firedoor protection. When the pipes were at the top of the openings, permanent brick transoms 8 in. thick and supported on channels were built in the upper part of the openings and the rest protected by firedoors. Similarly, sills were haised when pipes occurred at the bottom of the openings.

Occasionally, wood floor and roof beams were continuous through or over walls that were to be utilized as firewalls. Such timbers are to be cut at the wall and the ends separated by not less than 6 in. of cement mortar rammed so as to isolate thoroughly the woodwork on each side. When sufficient bearing is not remaining, steel stirrups shall be supplied.

All wood beams supported by firewalls are required to be beveled so as to be self-releasing in case of fire on either side of the wall. Dormer windows within 10 ft. of a firewall and within 2 ft. of the face of the exterior walls shall be protected by sheet-metal covering and fireproof window frames, sash and wire glass.

Typical Protection in Other Buildings

Another typical example of the firewall treatment is in the Infants Hospital Building on Randalls Island. This is a brick structure three stories and basement high, with wood interior and wood roof covered with slate in the mansard portions and with tar and felt in the flat portions. It is used as an administration building and a dormitory for feeble-minded boys.

In this building certain existing walls were utilized as firewalls. These were found to be more desirable for the purpose than walls coinciding with the projections

above the roof. An interesting problem was presented by a long wooden piazza with wood roof extending along the entire north side of the building east of the west wing. The piazza extended around the ends of all firewalls. The best solution was found to lie in fireproofing 20-ft. sections of the piazza adjacent to the ends of the firewalls. In the case of the dormitories for aged males and females in the City Home group, Blackwells Island, where similar three-story wooden balconies skirted the firewalls, the latter were extended through the balconies.

In the Farm Colony, Staten Island, four large new dormitories of nonfireproof construction, with stone walls, were divided into approximately two equal parts by new firewalls; but only in one other building of the 6 treated by the firewall principle (five in all) were new firewalls required. The appearance of the old and new firewalls above the roof may be noted in Fig. 2.

The views of interiors in Figs. 3 and 4 are typical of the appearance of the firedoors cut through the firewalls for horizontal exits.

Studies of Dredged Drainage Ditches Before and After Clearing*

By Charles E. Ramser†

SYNOPSIS—Carefully made hydraulic observations on the flow in dredged ditches to determine value of n under different conditions, with comparisons of values before and after clearing.

The following described experiments were made for the purpose of determining the value of the roughness coefficient n in Kutter's formula, for use in the design of drainage channels.

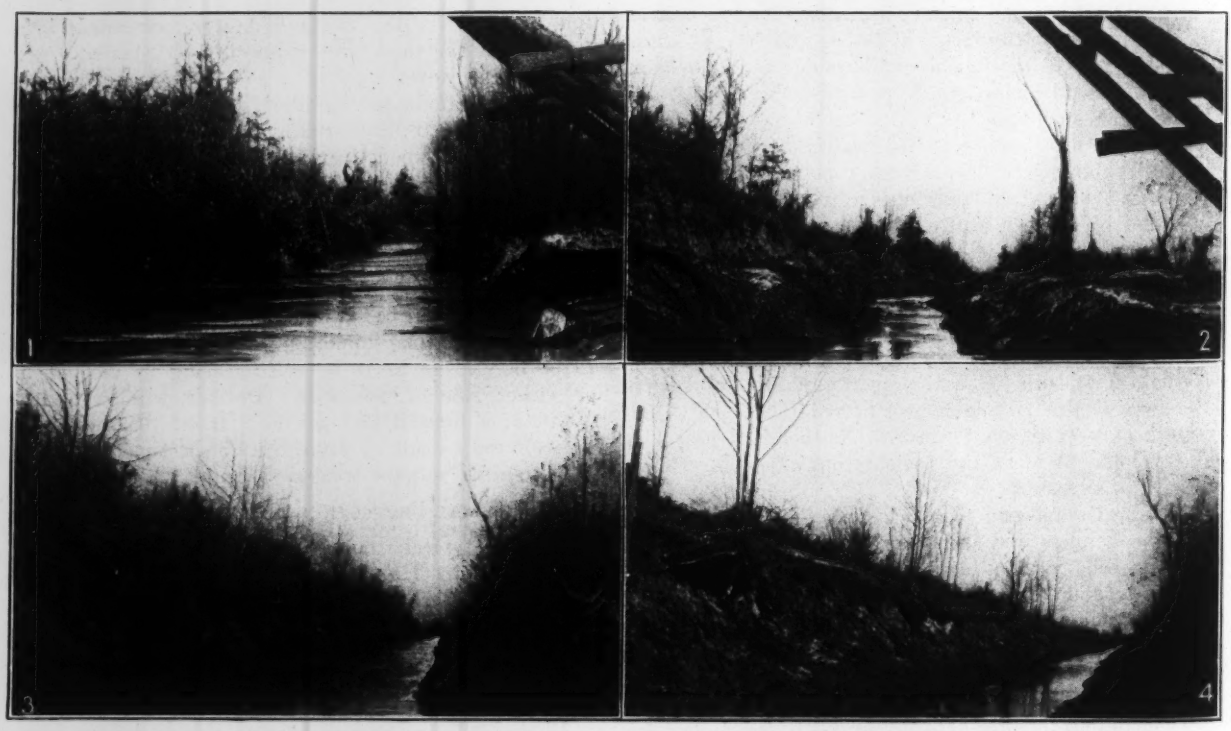
In these experiments, a straight and practically uniform course of channel was selected near each gaging section, so that no surface water and very little ground water entered the channel along the course. The slope of the water surface was determined by vertical measurements made down to the surface of the water from permanently set reference points. These reference points were placed on arms extending horizontally from vertical posts set firmly in the ground at each end of the course. Cross-sections of each channel were measured at intervals of 100 ft., from which the average values of the cross-sectional areas and hydraulic radii were determined for the course.

Slope and discharge measurements were made for the determination of the value of n for two dredged drainage channels—Mud and Old Town Creeks—near Tupelo, Miss., during the years 1913 and 1914.

An experiment for determining the effect upon the flow due to the clearing of Old Town channel was conducted.

*Condensed from a report by the author on Runoff Investigations and Determination of the Roughness Coefficient, n of Kutter's Formula, made in Lee County, Mississippi.

†Drainage Engineer, Office of Public Roads and Rural Engineering, United States Department of Agriculture, Washington, D. C.



FIGS. 1 TO 4. VIEWS OF OLD TOWN CREEK, LEE COUNTY, MISS., BEFORE AND AFTER CLEARING

Above course of slope measurements (1) before and (2) after clearing. On course of slope measurements (3) before and (4) after clearing

No clearing was done for the measurements made during 1913. One bank of the channel and part of the bottom was practically covered with small saplings, brush and cane and was quite irregular. The other bank was comparatively smooth and uniform with occasional growths of vegetation.

For the measurements during 1914, all brush, vegetation and other obstructions were cleared from the channel for 500 ft. above the upper end of the course and the same distance below the lower end. The soil in the channel is a solid black to yellow wax-like clay which is hard and erodes very little. The slope of the left bank is quite regular while that of the right bank is extremely irregular, which is due to the growth of vegetation causing the bank to erode unevenly. The views, Figs. 1, 2, 3 and 4, of Old Town Creek afford a good idea of the conditions existing in the channel before and after clearing.

FIG. 5. MUD CREEK, ALONG COURSE OF SLOPE MEASUREMENTS

Table 1 shows that the values of n for uncleared condition of channel of Old Town Creek range from 0.042 to 0.054 and between 0.0282 to 0.034 for cleared channel.

It is obvious from the values of n obtained before and after clearing that the efficiency of a canal is greatly decreased by permitting the growth of vegetation in the channel. For example, if n be taken as 0.045 before clearing and 0.03 after clearing, the discharge for Old Town Creek, at bank-full stage and for a slope of 0.0003, would be 590 and 858 sec.-ft. respectively, the latter discharge being 45.5% greater than the former.

It should not be inferred that clearing the channel for a short course increased the discharge for the course by the above amount, for only the clearing of the whole canal would accomplish this. However, the increased efficiency of the cleared part reduces the fall through that part and thereby increases the hydraulic gradient through the uncleared parts, thus tending to increase the efficiency and the discharge of the whole canal according to the length cleared.

A good idea of the condition and regularity of Mud Creek can be obtained from Fig. 5. The soil in the channel is a sandy wax-like clay which erodes very easily. This is a comparatively new channel, the ditch having been completed in January, 1913, and these measurements were made during the first part of 1914. Although some erosion has occurred, the ditch has retained its original uniform slope and comparatively uniform cross-sectional area. Table 2 shows the values of n obtained for Mud Creek.

TABLE 1. HYDRAULIC ELEMENTS OF OLD TOWN CREEK
Length of slope course, 1,224 ft. Channel uncleared.

Maximum Average Depth, Ft.	Surface Width, Ft.	Slope	Mean Hydraulic Radius	Mean Velocity, Ft. per Sec.	Average Cross-Section Area, Sq.Ft.	c	n
Data for 1913							
5.4	21.9	0.000518	2.90	1.25	76.2	32.8	0.0540
5.8	22.0	0.000513	3.12	1.47	85.5	36.9	0.0485
6.7	25.9	0.000444	3.55	1.66	108.2	41.8	0.0450
10.8	34.9	0.000388	5.30	2.16	231.8	47.9	0.0433
11.7	35.5	0.000445	5.78	2.22	261.0	43.8	0.0480
12.6	39.0	0.000452	5.95	2.26	298.2	43.5	0.0490
13.6	45.2	0.000375	6.06	2.41	341.5	50.5	0.0420
1914 (Channel Cleared)							
6.6	26.4	0.000271	3.37	1.73	107.0	57.4	0.0314
6.7	26.5	0.000305	3.42	1.98	110.2	61.4	0.0295
7.1	27.5	0.000290	3.53	2.00	120.0	62.3	0.0294
7.1	27.6	0.000279	3.58	2.02	120.0	64.1	0.0286
7.4	28.0	0.000267	3.69	2.05	127.0	65.5	0.0282
8.1	29.8	0.000271	3.95	2.18	142.3	66.6	0.0282
11.9	37.5	0.000346	5.70	2.68	265.0	60.3	0.0340
12.4	39.7	0.000268	5.95	2.76	295.5	69.3	0.0295
12.7	41.0	0.000346	6.05	2.87	307.4	63.0	0.0328

TABLE 2 HYDRAULIC ELEMENTS OF MUD CREEK
Length of slope course, 1,194 ft. Data for 1914

Maximum Average Depth, Ft.	Surface Width, Ft.	Slope	Mean Hydraulic Radius	Mean Velocity, Ft. per Sec.	Average Cross-Section Area, Sq.Ft.	c	n
2.6	18.5	0.000300	1.8	1.37	40.0	59.0	0.0264
2.8	19.3	0.000305	1.9	1.44	43.0	59.8	0.0264
2.9	19.5	0.000305	1.9	1.50	43.2	62.3	0.0255
3.2	20.5	0.000310	2.1	1.57	47.7	61.5	0.0262
3.8	22.0	0.000301	2.3	2.00	57.5	79.8	0.0221
4.0	22.6	0.000349	2.5	2.05	61.0	69.3	0.0246
4.1	22.8	0.000336	2.6	2.08	62.6	70.5	0.0244
4.9	24.7	0.000321	2.9	2.19	88.0	72.3	0.0243
4.95	24.8	0.000349	2.9	2.25	88.5	70.7	0.0247
5.0	24.9	0.000340	3.0	2.26	90.0	71.0	0.0248
9.9	32.5	0.000364	5.3	3.39	225.0	77.2	0.0260
10.65	34.5	0.000378	5.6	3.58	252.5	78.0	0.0254
10.70	34.5	0.000393	5.6	3.60	254.0	76.8	0.0260

It is seen that the values of n obtained for Mud Creek are lower than those for Old Town Creek. This is due to the facts that Mud Creek is a more recently constructed channel and the bottom slope and cross-sectional area are more uniform throughout the course than for Old Town Creek.

It appears that the proper value of n for ditches similar to Mud Creek is about 0.025, which means that the banks and sides should be fairly regular and free from any form of obstruction to flow, and the slope and cross-sectional area practically uniform. These conditions generally obtain only in new ditches, and it would therefore not be wise to use a coefficient as low as 0.025 in the design of drainage ditches, since the efficiency of a ditch generally decreases with age. It is recommended that in the design of such ditches the value of n be taken as 0.030, the approximate value obtained for Old Town Creek; but if it is not expected that the channel will be kept cleared of vegetation and other obstructions, a value as high as 0.040 or 0.045 should be used.

Quick Transit Through the Panama Canal was accomplished on Dec. 17 by the steamship "Acajutla" of the Pacific Steam Navigation Co. It entered the outer end of the buoyed channel at Balboa at 12:15 p.m. and dropped anchor in the harbor at Cristobal at 6:35 p.m., making the transit in 6 hours and 20 minutes, which is 5 minutes less than the best previous record. In the minority report of the Board of Consulting Engineers for the Panama Canal in 1906, comparative estimates were made of the time of passage through a lock canal and through a sea-level canal. The time of passage through the lock canal was then estimated at 9½ to 10 hours for a large freight steamer of 32 ft. draft. Results now obtained in the movement of ships through the canal show that the estimates made by the consulting engineers ten years ago were fairly accurate and at the same time conservative in their claims for the lock canal.

Engineering Literature

New Hydraulic Tables for Conduits

REVIEWED BY ROBERT E. HORTON*

FLOW OF WATER UNDER PRESSURE THROUGH CLEAN CLOSED PIPES: Tabulated Data with Explanatory Notes—By George T. Prince, C. E., M. Am. Soc. C. E. New York: D. Van Nostrand Co. Cloth; 4x7 in.; pp. v + 149; illustrated. $2.

This book contains a set of tables showing the discharge in pipes of various diameters for different friction heads and velocities. In this respect it covers the same ground as the tables by Edmund B. Weston, based on the D'Arcy formula, and the tables of Williams and Hazen, based on their own formula. It differs, however, from these and other earlier tables of friction head in pipes in some very marked respects. The fall in feet per thousand is used as the argument or independent variable instead of using the discharge or velocity, as has been done in most similar tables hitherto published. Which arrangement is better depends upon the problem to be solved. If the friction head for a given discharge is required, then the arrangement formerly used is most convenient. Probably, however, it is true that in more than half of the cases arising in water-works practice, especially conduit lines, the problem is to determine the size of pipe for a given capacity, or the capacity for a given size of pipe where the friction head is fixed in advance. For such problems the arrangement used by Prince is preferable.

Instead of giving the values of discharge in friction head for different sizes of pipe as determined from a single formula, as has generally been done in similar tables heretofore, this book contains the discharge for each size of pipe and for a series of different friction heads, as determined by five different formulas or methods, which include Kutter's formula with a coefficient of roughness 0.010, the D'Arcy formula, Lampe's formula, Fanning's formula and coefficients for friction head in pipes, and the formula $H_f = mv^{1.73}$. There are thus five entries under each size of pipe and for each friction head. Usually, the engineer engaged in the design of an important water-supply conduit desires to compare the results as to friction and discharge obtained by different formulas. In so far as such a comparison involves the five formulas referred to, the work is already done in a very neat and satisfactory manner in these tables. The tables are also more complete as to sizes of pipes than most others hitherto presented, as they cover a range of pipes from 4 to 48 in. in diameter by increments of 2 in., and from 48 to 120 in. in diameter by increments of 6 in.

In addition to the friction head and velocity, the discharge is given in each case in terms of cubic feet per second, United States gallons per minute, and millions of gallons per 24 hr. The coefficient C in the Chezy formula, which would give the same result as derived from each of the different formulas used in preparing the tables, is also given for the convenience of engineers who prefer to work from the coefficient C rather than from the coefficient of roughness in applying the Kutter and Chezy formulas.

The book had its inception in studies made by the author on the flow in continuous wood-stave pipe, and the tables seem to have been prepared primarily with reference to wood-stave rather than cast-iron pipe. The author adopts the coefficient of roughness 0.010 in the Kutter formula as applicable to wood-stave pipe. While this value of n is often obtained in new wood-stave pipe in excellent condition, it is a lower figure than many engineers would adopt as a basis of design.

D'Arcy's, Fanning's and Lampe's formulas have been considerably used for cast-iron pipe, but not generally for wood-stave pipe, and there are a number of recent formulas for calculating the flow and friction head in wood-stave pipe, including those of Tutton, Noble, Moritz and Scobey, which are not referred to in this book.

It appears that no examples are given illustrating the use of the tables. Such tables are commonly employed for the solution of problems involving the flow in compound or branching mains, and illustrations of their application for these problems would be generally helpful.

The introductory chapter contains some discussion of formulas used and of the development of friction-head and pipe-flow formulas. It is accompanied by an elementary statement of the methods of straight-line plotting of experimental data on logarithmic paper.

The author takes the position, which appears wholly logical, that no general rules can be laid down for deterioration in pipe capacity with increased age, inasmuch as the deterioration is largely a function of the character of the water and depends as much, or more, on the amount of suspended matter and hardness of the water as upon the age of the pipe itself. He gives, however, a table of average values of capacity-depreciation factors, based on experience in a western city.

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Municipal Engineering Gaps Filled

MUNICIPAL ENGINEERING PRACTICE—By A. Prescott Folwell. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. xi + 422; 113 illustrations. $3.50 net.

By presenting a fair amount of the theory and a considerable wealth of the detailed practice of certain fields of municipal engineering the author has filled some gaps in the recent literature of the subject. Leaving water-supply, sewerage and paving nearly alone, as well taken care of in existing books, the author traverses nearly all the other lines of work with which the municipal engineer has occasion to deal.

After taking up such fundamental data as population, Mr. Folwell reviews the various elements of the city plan. This section is an epitome of city planning, chiefly from the engineering viewpoint. Then follow eight chapters dealing with as many divisions of city engineering and allied work. These have to do with various details of street surface other than paving, such as sidewalks, curbs,

gutters and street-railway tracks; bridges, viaducts and the treatment of water courses and waterfronts; city surveying; street lights, street signs and house numbers; the sprinkling and cleaning of streets; the collection and disposal of garbage and other city refuse; public markets, comfort stations and baths; and parks, cemeteries and shade trees.

The book contains much that is well designed to interest and assist various councilmanic committees and heads of municipal administrative departments, besides being particularly well adapted to the needs of city and town engineering staffs. The illustrations are particularly commendable, both halftones and line drawings, as aids to the text and often as driving home a story of their own.

Traffic Through Panama Canal

THE PANAMA CANAL AND COMMERCE—By Emory R. Johnson, Ph.D., Sc. D., Professor of Transportation and Commerce, University of Pennsylvania; Member Isthmian Canal Commission, 1899-1904; Special Commissioner of Panama Canal Traffic and Tolls, 1911-13. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. 296; illustrated. $2 net.

There is no higher authority on the subject covered by this book than Professor Johnson. As a member of the Isthmian Canal Commission of 1899-1904, he had charge of the investigation to determine the probable commerce that would seek the canal after completion. A decade later he was made special commissioner on Panama Canal traffic and tolls, and it was under his direction that the present system of tonnage measurement and tolls was worked out. An idea of the scope of the book may be obtained from the titles of some of the principal chapters: Why the Canal Was Built; The Canal and Freight Rates; The Canal and Domestic Trade and Industry of the United States; The Canal and the American Marine; Competition of the Suez and Panama Routes; Fuel Supplies and Costs via the Panama Canal and Alternative Routes; The Panama Canal Tolls; What Happened When the Slides Closed the Canal.

The revolutionary situation in ocean traffic that has existed ever since the canal opened has made more or less problematical many questions as to the volume and character of traffic through the canal, which in the ordinary course of events would now be well settled. Added to this has been the disorganization of traffic through the closing of the canal by slides for about seven months during its second year of operation.

The author believes that the canal has already been of large benefit to the western part of the United States and Canada, but the extent to which the canal will stimulate business between the United States and countries on the western side of the Pacific he considers still uncertain.

In the chapter on the competition of the Suez and Panama routes the author quotes the result of an extended investigation made by M. Casimir-Perier as to the loss of traffic that the Suez Canal would experience when the Panama Canal was opened to traffic. The conclusion reached was that the loss would probably not amount to over 300,000 tons per annum. This is a very small percentage of the Suez Canal traffic, which amounted to 16,500,000 tons in 1910 when the investigation was made. While Professor Johnson thinks this estimate too small, he holds that the two canals are to be regarded as supplementary routes quite as much as competitive rivals. He thinks that the stimulus to industrial progress and international trade resulting from the Panama Canal will eventually cause the Suez Canal business to be larger than it would have been had the Panama Canal not been built.

One very important factor in the future of the Panama Canal as a trade route is the cost of steamship fuel. The author believes that owing to the Panama Canal being located comparatively near the chief coal-shipping ports in the United States, the price of fuel will probably rule lower there than on the sailing routes through the Mediterranean or around the Cape of Good Hope.

Special interest attaches to the chapters on the Panama tolls and the Panama tonnage rules, for which the author was responsible. It will be remembered that after the canal had been in operation for some months it became necessary to make refunds to a considerable number of the vessels that had used the canal, because the net registered tonnage fixed by United States Government rules for the measurement of vessels under the interpretation of the Commissioner of Navigation gave lower tonnages on some vessels than the Panama tonnage rules worked out by Professor Johnson. It is at present necessary for the canal officers at Panama to determine for each vessel whether its tonnage by United States measurements will be less than its tonnage measured by the Panama rules. A bill to remedy this situation is pending in the House of Representatives.

The forecast of business made prior to the completion of the canal indicated that the net tonnage of shipping would amount to about 10,500,000 tons per annum during the first years of operation, with an increase at the rate of at least 60% in the first decade, so that it would reach 17,000,000 by 1925. With a traffic of this volume and the present rates of toll it was computed that the revenues at the end of the decade would be sufficient to pay the canal operating expenses, maintenance and interest charges on its cost. The expected volume of traffic has not materialized, due to the slides and the war, but the author believes that, when normal international and domestic trade conditions are reëstablished, his forecast as to its commercial importance will be justified.

Weight of Steel Shapes

ELLIOTT'S WEIGHTS OF STEEL, for Engineers, Architects, Contractors, Builders, Steel Manufacturers and all Users of Rolled Steel—A set of tables that enable the user to tell instantly and without calculation of any kind, except an occasional bit of simple addition, the weight of any given piece of rolled or drawn-steel. Computed by Thomas J. Elliott. Cleveland, Ohio: The Penton Publishing Co. Leather; 6x9 in.; pp. 662; thumb index. $20.

The purpose of this collection of tables is to enable one to find the weight of a single piece of any section of rolled steel without having to perform the operation of multiplication. Having found the weight of a lineal foot of any section of rolled steel or rolled plate from the "Shape Books" of the steel manufacturers, all that is necessary to determine the total weight is to turn to the page corresponding to the unit weight of the shape. Here will be found the weights of $\frac{1}{16}$ in. to 60 ft. in length of this particular shape.

The tables in this book give weights of $\frac{1}{16}$ in. to 60 ft. in length of rolled steel weighing 1 to 300 lb. per lin.ft., and the weights of the same lengths weighing 0.01 to 0.99 lb. per lin.ft., and shafting and reinforcing-rod tables. The comprehensive stub index makes the right table easy to find, while the simple arrangement of the data makes the tables easy to use.

Mortality Tables and Their Making

REVIEWED BY G. C. WHIPPLE*

MORTALITY LAWS AND STATISTICS—By Robert Henderson, Actuary of the Equitable Life Assurance Society of the United States. New York: John Wiley & Sons. [Mathematical Monographs; edited by Mansfield Merriman and Robert S. Woodward.] Cloth; 6x9 in.; pp. v + 111; illustrated. $1.25 net.

The interest in life tables is being revived. This is partly due to recent writings of actuaries of life-insurance companies, but also to the fact that public health officials and the United States Census Bureau itself are taking up the matter. The advantage of life tables over other forms of expression of mortality statistics is that they are more readily visualized by the average person than are the specific death rates upon which the life tables are based.

Mr. Henderson, who is the actuary of the Equitable Life Assurance Society, has given in this work a description of what mortality tables are and how they are prepared. The methods used are necessarily complicated, and this book is not for the average reader. It will be found interesting and valuable, however, to all who desire to look below the surface of vital statistics and to use the data in the most effective way.

The book contains the principal experience tables that have been issued since the time of Halley, the astronomer, who was the first statistician to use this form of expression. The author calls attention to some of the popular misunderstandings in regard to mortality tables and in particular to the fact that tables showing "expectations of life" are not used as a basis of computing the premiums of life insurance. The work is confined to the mortality tables and does not enter upon their combination with the theory of compound interest. The book is No. 15 of the series of mathematical monographs noted in the title heading.

New Formulas for Flow of Water

THE FLOW OF WATER IN WOOD-STAVE PIPE—By Fred C. Scobey, Irrigation Engineer, with Discussion by Gardner S. Williams, Theron A. Noble, D. C. Henny, E. A. Moritz, E. W. Schoder, L. M. Hoskins. Washington, D. C.: United States Department of Agriculture, Office of Public Roads and Rural Engineering, Logan Waller Page, Director. Bulletin 376. Paper; 6x9 in.; pp. 96; illustrated. 25c. per copy from Superintendent of Documents.

Mr. Scobey describes in this professional paper of the Office of Public Roads and Rural Engineering the development of a new exponential formula for flow of water in wood-stave pipes. His studies convinced him that this type of expression is more adapted to pipes running full under pressure than the Kutter formula. These new equations,

$$H = \frac{7.68\,V^{1.8}}{d^{1.17}} = \frac{0.419\,V^{1.8}}{D^{1.17}}$$

$$V = 1.62\,D^{0.65}H^{0.555}$$

$$Q = 1.272\,D^{2.65}H^{0.555}$$

follow the form of the Moritz formulas, but have different constants and exponents. The Moritz formulas were based on one man's experiments with a limited range of pipe diameters. The new expressions are based on all the wood-stave pipe experiments on record and, in addition, on the results of an extensive series of new experiments.

Descriptions of tests, interpretation of data and the use of the expressions are set forth in this volume. There are a logarithmic diagram and a set of tables, based on these formulas, for designing pipe. The only connection between these studies and their use for other pipe lines lies in the statement that "wood-pipe will convey 15% more water than a 10-year-old cast-iron pipe, or a new riveted pipe, and about 25% more than a 20-year-old cast-iron pipe or a 10-year-old riveted pipe."

Appended to the main text are criticisms of the advance proofs by Williams, Noble, Henny, Moritz, Schoder and Hoskins.

Cost Keeping by a Cost Accountant

COST ACCOUNTING AND BURDEN APPLICATION—By Clinton H. Scovell, C. P. A., Assoc. Am. Soc. M. E. New York: D. Appleton & Co. Cloth; 6x8 in.; pp. xiv + 328. $2 net.

The principles and elements of cost are treated by Mr. Scovell rather than any specific system of cost keeping. The determination and application of overhead charges or burden are given a prominent place. The five methods of applying burden are: Percentage on wages, percentage on labor and material, man-hour rates, old-machine rate, new-machine rate. The first three methods are well known. The old-machine rate is rarely used, but the new-machine rate, for reasons given at length, is coming to be accepted as the best to use under conditions to which it applies. This method contemplates the analysis of all the factors making up the manufacturing burden, in order that the proper overhead may be known for each department and for each production center in each department. The total burden divided by the standard number of operating hours in a year gives the machine-hour rate, "which is used to charge burden to the cost of orders in proportion to the length of time which each order uses the manufacturing facilities afforded by its production center."

Material and material cost with reference to the practice of machine shops are discussed in Chapter III. The succeeding chapter is on labor costs. The later chapters deal with cost accounting for special industries. The chapter on paper manufacturing costs is especially pertinent at this time of extremely high prices for that commodity. Another chapter discusses the cost of power and steam with special regard to distributing the cost correctly. The chapter on the Cost Department emphasizes the fact that the value of such an organization does not consist alone in the cost-*finding*, but also in cost-*accounting*, a work much broader and much more valuable to the management.

The author states that every method and device mentioned in the book is in successful operation in some progressive industrial establishment. According to the credit given, the subject matter of the several departments of the book has been carefully checked by competent men.

Settling Industrial Disputes

MEDIATION, INVESTIGATION AND ARBITRATION IN INDUSTRIAL DISPUTES—By George E. Barnett, Ph. D., Professor of Statistics, Johns Hopkins University, and David A. McCabe, Ph. D., Assistant Professor of Economics, Princeton University. New York: D. Appleton Co. Cloth; 5x8 in.; pp. viii + 209. $1.25.

Settling disputes between capital and labor is becoming an increasingly trying task and one calling for skill, patience, courtesy and a knowledge of both human nature and national economic conditions by the arbitrators on both sides. Industrial belligerence will no doubt continue

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for many years to come, and any light of experience that can be shed upon the question should be taken advantage of by interested parties. This particular study of mediation, investigation and arbitration is based on a report, submitted in June, 1916, by the authors, to the Commission on Industrial Relations. The book is divided into three parts. The first deals particularly with the title subject. The second discusses proposed new agencies and a suggested plan of a national system of mediation, investigation and arbitration. The third part contains extracts from the report of the commission.

Advances in Paint Technology

REVIEWED BY ROBERT JOB*

THE CHEMISTRY AND TECHNOLOGY OF PAINTS—By Maximilian Toch, author of "Materials for Permanent Painting." New York: D. Van Nostrand Co. Second revised edition. Cloth; 6x9 in.; pp. 366; 83 photomicrographic plates and other illustrations. $4 net.

The original edition of this work was published in 1907 with 161 pages, compared with 353 pages in the present edition. The additions and changes are due to advances in the production of new pigments and paints as well as in methods of manufacture. The same general arrangement of the book is followed as in the first edition, but so much new material has been added that the new volume will be found useful even by those who are familiar with the other.

During the past decade there have been radical changes in the paint industry, and pigments and oils which 10 years ago were little known by the general public are far better understood, due in part to the legal requirements as to labels. There is also today a much clearer understanding by consumers as to the use of the so-called "inert" pigments or "extenders," and it is quite generally known that their presence in proper proportions is not only permissible, but necessary and highly desirable if the best results are desired. The various types of these pigments are discussed in detail. Descriptions are given of white pigments, including zinc-lead, basic sulphates, lithopone, etc. Lithopone is a valuable pigment when used under certain conditions, but it might not be amiss to mention its failure in paints exposed to weathering, as shown in the tests made at Atlantic City by the American Society for Testing Materials.

The use of red lead for the priming coat upon structural steel is well known everywhere, but it is not so clearly understood that other paints can readily be obtained which are equally serviceable and which are far easier of application. Mention is also made of various combinations that are made with red lead to prevent rapid settling in the can and to enable the average painter to secure a more even coating than is frequently the case in ordinary practice when using pure red-lead paint.

Fortunately for the consumer, some of the most durable results in painting can be secured with the least expensive materials and by correct use of inert materials. Oxide of iron is an excellent protective pigment when properly ground, and the same statement may be made of many of the less expensive pigments. As a result the purchase of paint materials under specifications and competitive bidding has increased widely and is a common practice today. It frequently results in radical saving to the consumer in money cost, and frequently also with decided improvement in service.

Separate chapters follow upon colored pigments—red, brown, yellow, blue, green and black respectively. Helpful information is given as to various combinations that cannot be used successfully and the conditions under which permanency of color can be expected.

It is not generally appreciated that a pigment often gives much better service when diluted with suitable extenders, such as clay, silex, abestine, etc. For example, a pure graphite paint is unnecessarily expensive; and also better service results can be obtained by addition of considerable proportions of extenders or "fillers," such as those mentioned above, using proper precautions to have the paint finely ground and in proper physical condition.

Formulas are given for paints for special purposes and also the difference in the proportions of oil and volatile matter for priming coat for subsequent coats.

Soya bean oil and especially china-wood oil are used very considerably in paints today; and a useful summary of information is given regarding these and other oils and their properties, with methods for testing their purity and also a description of turpentine and the various substitutes for the latter which have been developed in recent years (some of them with very satisfactory results). Cobalt driers are also a recent development of much value for certain purposes.

Methods for analysis of pigments and of oils are given in detail and will be of service to the paint chemist, also tables of specific gravities, etc.

The text is quite free from typographical errors, although upon page 139 the percentage of water in gypsum is stated as 48.85%—evidently intended to be 18.84%.

The reviewer believes that the book will be of interest to both manufacturers and consumers of paints.

Useful Park Text and Handsome Views

PARKS: Their Design, Equipment and Use—By George Burnap, Landscape Architect of Public Buildings and Grounds, Washington, D. C.; Lecturer in Landscape Design, University of Pennsylvania. With an Introduction by Richard B. Watrous. Philadelphia: J. B. Lippincott Co. Cloth; 7x10 in.; pp. 328; colored frontispiece, 163 halftones and four diagrams. $5.

There has long been need for a book on parks, written primarily for the benefit of the layman park official and the student, but yet with the knowledge and insight of the professional park designer and superintendent. Mr. Burnap's book goes far toward meeting this need.

After general chapters on park design, the various classes of parks are treated, and many of the troublesome questions relating to playgrounds in parks are answered. Monuments and architecture in parks are next considered, after which follow interesting and instructive chapters on water as a decorative feature and the planting design of parks, including in the latter the relation of administration to planting design. There is a useful chapter on seats in parks, a chapter on various park utilities and one on the disposition of flowers in parks.

The volume is profusely illustrated with well-chosen and finely executed views, of which there is one opposite each page. These views fill two-thirds of the height of the page, leaving the remaining third for a "boxed" title and subtitle, the "box" corresponding to the heavy hatched border around the halftone. The arrangement is æsthetically pleasing, but some of the subtitles are ob-

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scurely worded, and the illustrations and their explanations are, as a rule, very poorly correlated with the text. In fact, an engraving opposite practically every page of text, but more often than otherwise not directly connected with the latter, is sometimes distracting to the reader. The text contains general references to the illustrations, but no page references. There would have been a gain in utility and little if any loss æsthetically if the illustrations pertinent to each chapter had been placed at the chapter end. This change in arrangement, with more care in the wording of the subtitles to the views, would have made the illustrations go much farther than they do in telling a unique story of their own.

If the subject matter of the text seems inadequate to any readers of this notice, they should take cognizance of the fact that three companion volumes are in preparation—on "Gardens," "Pictorial Planting" and "Landscape Art." It is partly with this in view that we have ventured to make the foregoing comments on the illustrations in the volume now under consideration. If the author and publishers feel that the series, as contributions to art literature, demand the rather sumptuous style of the present volume, it is to be hoped that they may eventually find it practicable to issue a more utilitarian edition. Bulk, weight and price could be cut nearly, if not quite, in half without sacrifice of utility, making the volume handier and bringing it within the reach of a much larger circle of readers.

Life Sketches of Great Mathematicians

TEN BRITISH MATHEMATICIANS—By Alexander MacFarlane. New York: John Wiley & Sons, Inc. [Mathematical Monographs; edited by Mansfield Merriman and Robert S. Woodward.] Cloth; 6x9 in.; pp. 150. $1.25.

There are at least two types of mathematical mentality—that which cannot perform the simple mechanical processes without a strong likelihood of error, yet can work out on paper the most intricate equation, and the one that can extract cube root without using a pencil. The ten pure mathematicians whose careers are sketched by Dr. McFarlane, now deceased, include prodigies of both types. The period covered is from 1791 to 1884.

An especially interesting characteristic of great mathematicians is their almost universal love of poetry. Clifford is said to have remarked that mathematics and poetry are sisters, and he himself helped to justify his statement by writing at least one very creditable poem. William Rowan Hamilton also was a poet, and J. J. Sylvester wrote a book entitled "The Laws of Verse." He must have felt some pride in this work, because he signed one of his mathematical communications, "J. J. Sylvester, Author of 'The Laws of Verse'."

Poetry is by no means the only mental relaxation of the mathematician. Clifford once devoted 12 hours to reviewing a book based on the following anagram:

$$A^8C^3DE^{12}F^4GH^6L^3M^3N^5O^6PR^4S^5T^{14}U^6V^2WXY^2$$

This alphabetical series is translated, "Thoughts conceived to affect the matter of another universe simultaneously with this may explain a future state."

Hamilton was knighted and two years later became President of the Royal Irish Academy, but his highest title to fame rests on his work on quaternions. At the time of his death the "Elements of Quaternions" was finished with the exception of one chapter. The book was published, only 500 copies being printed. In consequence it soon became a rare book, and as much as $35 has been paid for a copy.

Thomas Penyngton Kirkman, ordained a minister, in addition to important mathematical work devoted some time toward bringing "the memory of the vocal organs and the ear to the assistance of the reasoning faculties," writing a book on the subject. It was he who published in the "Ladies' and Gentlemen's Diary" in 1850 the famous problem of the 15 school girls who walked out of school three abreast, the problem being to determine how many arrangements can be made so that no two will be abreast more than once. The answer is 35 and may be proved by those equipped for such work.

Dr. MacFarlane's book, which is a collection of lectures delivered by him at Lehigh University, should appeal to all students of human nature. It is, however, of more special interest, because not only are the personalities drawn, but the work and achievements of these men are presented and discussed in considerable detail. In addition to the names mentioned in the foregoing the careers of the following mathematicians are sketched: George Peacock, Augustus DeMorgan, George Boole, Arthur Cayley, Henry John, Stephen Smith and Isaac Todhunter.

Lectures on Alternating Currents

ALTERNATING CURRENTS—By Carl Edward Magnusson, M. S., Ph. D. E. E., Professor of Electrical Engineering, University of Washington; Fellow, Am. Inst. E. E. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xv + 525; 475 illustrations. $4 net.

Another addition has been made to the already long list of electrical teaching texts that are primarily lecture notes arranged to satisfy the specific needs of specific institutions. By stating that the book, even though having 500 odd pages, covers only fundamentals, the scope is indicated. The treatment is of theory, not heavily loaded with field and shop practicalities, and aims to help students to gain an idea of internal reactions and to handle certain physical facts in mathematical shorthand. Transformers are taken up after voltage generation and circuit properties. This is followed by motors, generators, converters, insulation, polyphase power, long-distance transmission. The chief feature of originality lies in pushing the study of transmission lines farther than common with undergraduates.

Guide to the Ford Automobile

THE MODEL T FORD CAR: Its Construction, Operation and Repair—By Victor W. Page, Member of the Society of Automobile Engineers; author of "The Modern Gasoline Automobile." New York: Norman W. Henley Publishing Co. Cloth; 5x8 in.; pp. 228; 94 illustrations. $1.

The author of this book is well known as the writer of a number of thoroughly practical treatises on automobile engineering. He states that the close of 1916 will see at least 1,000,000 Ford cars of all types in use. Without doubt there has never been in the whole history of mechanical engineering a machine of equal size, complication and cost produced in such immense numbers.

The author has endeavored to give the non-technical reader an idea of the elementary mechanical principles involved in the various parts of the Ford car, and at the same time to give practical instructions governing its operation, maintenance and repair. The book has the same liberal provision of excellent illustrations that characterizes the other automobile books by the same author.

By making relatively slight changes in construction details of a nonfireproof building, its fire resistance can be greatly increased. Specific points of advice are given in the pamphlet "Structural Defects; Suggestions for Their Elimination and Protection," issued by the National Fire Protection Association. This little publication gives illustrated directions as to how and where to place fire stops. In so doing it hits at the characteristic weakness of stud framing, the commonest form of wood-frame construction. Of almost equal value, however, are pointers on safeguarding stair openings, belt and shaft openings in floors and walls, and similar special elements of fire hazard. For those who have the responsibility of keeping up and caring for wood-frame buildings, the pamphlet is a most necessary piece of educational literature.

Recent installments of the "Geological Atlas of the United States" include the "Galena-Elizabeth Folio, Illinois-Iowa" and the "Colorado Springs Folio, Colorado." (Washington, D. C.: United States Geological Survey; 25c. each.)

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ANNUAL REPORT OF THE GOVERNOR OF THE PANAMA CANAL for 1915-16—Balboa Heights, Canal Zone: Department of Operation and Maintenance. Paper; 6x9 in.; pp. xxiii + 637; illustrated, maps and diagrams.

COAL IN 1915—By C. E. Lesher. Mineral Resources of the United States, 1915, Part II. Washington, D. C.: United States Geological Survey. Paper; 6x9 in. Part A, Production; pp. 345-431; illustrated. Part B, Distribution and Consumption; pp. 433-513.

ELEMENTS OF HYDRAULICS—By S. E. Slocum, B. E., Ph.D., Professor of Applied Mathematics in the University of Cincinnati. New York: McGraw-Hill Book Co., Inc. Second edition, revised and enlarged. Cloth; 6x9 in.; pp. xvi + 329; 221 illustrations. $2.50 net.

GOVERNMENT TELEPHONES: The Experience of Manitoba, Canada—By James Mavor, Ph. D., Professor of Political Economy in the University of Toronto. New York: Moffat, Yard & Co. Cloth; 5x8 in.; pp. viii + 175. $1 net.

HYDRO-ELECTRIC POWER—By Lamar Lyndon. New York: McGraw-Hill Book Co. Cloth; 6x9 in. Vol. I, Hydraulic Development and Equipment; pp. vii + 499; 235 illustrations. $5. Vol. II, Electrical Equipment and Transmission; pp. vii + 360; 194 illustrations. $3.50.

MODERN UNDERPINNING: Development, Methods and Typical Examples—By Lazarus White, C. E., and Edmund Astley Prentis, Jr., E. M. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. xii + 94; 48 illustrations. $1.50 net.

MODULES AND UNIFORM DISCHARGE DEVICES FOR IRRIGATION AND WATER-WORKS: Excerpt Minutes of Proceedings of Institution of Mechanical Engineers, October, 1916—By Hugh Munro, M. Inst. M. E. London, S. W., England: The Institution. Paper; 6x9 in.; pp. 507-555; illustrated.

THE NATIONAL CYCLOPÆDIA OF AMERICAN BIOGRAPHY. Edited by Distinguished Biographers. New York: James T. White & Co. Vol. XV. Cloth; 8x11 in.; pp. 416; 700 illustrations. $10.

NATURAL GAS IN 1915—By John D. Northrop. Mineral Resources of the United States, 1915, Part II. Washington, D. C.: United States Geological Survey. Cloth; 6x9 in.; pp. 927-1015; illustrated.

THE PHYSICO-CHEMICAL PROPERTIES OF STEEL—By C. A. Edwards, D. Sc., Professor of Metallurgy, Manchester University. London: Charles Griffin & Co. Philadelphia: J. B. Lippincott. Cloth; 6x9 in.; pp. x + 229; 181 illustrations. $3.50 net.

This book was noted briefly in the issue of Nov. 16, but inadvertently the name of the publisher was left out.

PIPE AND THE PUBLIC WELFARE—By R. C. McWane. New York: The Author, 1 Broadway. Cloth; 5x8 in.; pp. 165; illustrated. $1 net.

PRACTICAL HANDLING OF IOWA CLAYS, with Application of Ceramic Principles—By Homer F. Staley, Ceramic Engineer, and Milton F. Beecher, Formerly Assistant Ceramic Engineer. Ames, Iowa: Iowa State College of Agriculture and Mechanic Arts. Bulletin 43, Engineering Experiment Station. Paper; 6x9 in.; pp. 48; illustrated.

PRACTICAL STREET CONSTRUCTION—Planning Streets and Designing and Constructing the Details of Street Surface, Subsurface and Supersurface Structures.—New York: Municipal Journal and Engineer. Reprinted from a series of articles that appeared in "Municipal Journal." 1916. Cloth; 6x9 in.; pp. viii + 248; 151 illustrations. $2.

PROCEEDINGS OF THE FOURTH ANNUAL MEETING OF THE MONTANA INSTITUTE OF MUNICIPAL ENGINEERS, 1916—Billings, Mont.: John N. Edy, Secretary. Paper; 6x9 in.; pp. 98.

REPORT OF THE WATER CONSERVATION AND IRRIGATION COMMISSION, 1916—Sydney, Australia. Paper; 8x13 in.; pp. 128; illustrated.

REPORT ON COÖPERATION IN AMERICAN EXPORT TRADE—Washington, D. C.: Federal Trade Commission. In two parts. Paper; 6x9 in. Part I, Summary and Report; pp. xv + 387; 5 charts and 29 tables. Part II, Exhibits; pp. xxiii + 597; 15 tables.

REPORT ON IRRIGATION SURVEYS AND INSPECTIONS, 1915-16—Ottawa, Canada: Department of Interior, Irrigation Branch. Paper; 7x10 in.; pp. 86; illustrated.

REPORT ON MUNICIPAL FINANCES: Statistics of Cities and Towns of Iowa, 1915-16—Des Moines, Iowa: Frank S. Shaw, Auditor. Cloth; 6x9 in.; pp. xvi + 294.

A SERIES OF TREATISES ON THE RARE METALS: Tungsten, Molybdenum; Vanadium, Uranium—By Dr. Herman Fleck. Proceedings of the Colorado Scientific Society, Vol. XI. Denver: The Society. Paper; 6x10 in.; pp. 103-176.

SPECIFICATIONS AND TOLERANCES FOR WEIGHTS AND MEASURES AND WEIGHING AND MEASURING DEVICES, as adopted by the Eleventh Annual Conference on the Weights and Measures of the United States, Held at the Bureau of Standards, Washington, D. C., May 23-26, 1916, and Recommended by the Bureau of Standards for Adoption by the Several States—Washington, D. C.: Bureau of Standards. No. 61. Paper; 7x10 in.; pp. 44. 10c. per copy from Superintendent of Documents.

STANDARDS OF MECHANICAL FILTRATION PLANT PERFORMANCE—By Abel Wolman, Resident Engineer, Northern District, Maryland State Department of Health. [Baltimore, Md.] Reprinted from "American Journal of Public Health," Vol. 6, No. 11. Address the Author. Paper; 7x10 in.; pp. 1153-1161; illustrated.

Coefficients of efficiency are proposed for the reduction of both the total and the colon bacteria.

STEEL RAILWAY BRIDGES: Designs and Weights—By Edward C. Dilworth, Assoc. M. Am. Soc. C. E. New York: D. Van Nostrand Co. Cloth; 12x10 in.; pp. viii + 185; 105 full-page plates. $4 net.

SURFACE WATER-SUPPLY OF THE UNITED STATES, 1913: Part XI, Pacific Slope Basins in California—By Nathan C. Grover, Chief Hydraulic Engineer, H. D. McGlashan and F. F. Henshaw, District Engineers. Washington, D. C.: United States Geological Survey. Water-Supply Paper 361. Prepared in coöperation with the State of California. Paper; 6x9 in.; pp. 514; illustrated. 10c. a copy from Superintendent of Documents.

TRANSACTIONS OF THE AMERICAN CERAMIC SOCIETY, Vol. XVIII, 1916—Columbus, Ohio: The Society. Cloth; 6x9 in.; pp. 947.

THE TYPHOID TOLL—By George A. Johnson. Reprinted from the "Journal" of the American Water-Works Association, Vol. 3, Nos. 2 and 3, June and September, 1916. Paper; 6x9 in.; pp. 144; tables and diagrams.

The space is divided equally between Mr. Johnson's valuable paper before the recent convention of the association named, and oral and written discussion by many engineers and sanitarians.

UNDERGROUND LATRINES FOR MINES—By Joseph H. White. Washington, D. C.: Bureau of Mines. Technical Paper 132. Paper; 6x9 in.; pp. 23; illustrated. 10c. a copy from Superintendent of Documents.

UNDERGROUND TRANSMISSION AND DISTRIBUTION for Electric Light and Power—By E. B. Meyer, M. Am. Inst. E. E., M. Am. Soc. M. E. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 312; 156 illustrations. $3 net.

THE USE OF MUD-LADEN FLUID IN OIL AND GAS WELLS—By James O. Lewis and William F. McMurray. Washington, D. C.: United States Bureau of Mines. Bulletin 134, Petroleum Technology, 36. Paper; 6x9 in.; pp. 86; illustrated. 15c. a copy from the Superintendent of Documents.

VAPOR PRESSURES OF VARIOUS COMPOUNDS AT LOW TEMPERATURES—By G. A. Burrell and I. W. Robertson. Washington, D. C.: United States Bureau of Mines. Technical Paper 142. Paper; 6x9 in.; pp. 32; illustrated. 5c. a copy from Superintendent of Documents.

WATER POWERS OF CANADA—Reprint of a series of five monographs covering the water-power situation in Canada, prepared for distribution in connection with the exhibit of the Dominion Water Power Branch in the Canadian Pavilion at the Panama-Pacific International Exposition, San Francisco, 1915. Ottawa, Canada: Dominion Water Power Branch. Water Resources Paper No. 16. Paper; 7x10 in.; pp. 363.

WEATHERING OF COAL: An Investigation of the Coals of Canada with Reference to Their Economic Qualities, as Conducted at McGill University, Montreal, Under Authority of the Dominion Government—By J. B. Porter, E. M. Ph. D., D. Sc.. Paper; 7x10 in.; x + 194; illustrated.

Notes from Field and Office

Paving alley returns—Blasting a rock ledge from New York Harbor—Adding five stories to an eight-story building—Concreting footings of viaduct 196 ft. high—Floating steam shovel

Paving Alley Returns in Chicago

In paving the alley returns of streets in Chicago it is now the general practice to make the top of the paving practically flush with the 6 ft. of the sidewalk next the property line and to give a straight slope at the center from the property line toward the street gutter. This method avoids the usual step at the alley and gives an almost unbroken sidewalk. The plan is not used where there is an excessive slope toward the street gutter or where there is much heavy teaming in the alleys.

Where the concave in the alley return is increased to enable its sides to be brought up to the sidewalk level, the slopes from the sidewalk to the center may be rather steep. With wood-block paving these slopes are likely to become slippery in bad weather. To prevent this condition the practice of the Board of Local Improvements is to lay the blocks parallel with the center line of the alley and with ¼-in. open joints formed by creosoted strips. These strips are about half the depth

METHODS OF PAVING OF ALLEY RETURNS IN CHICAGO STREETS

of the block, the upper half of the joint space being filled with coarse sand. Another method employed is to lay the blocks at an angle, so that the edge of each row is ¼ in. above that of the adjacent row, thus forming a saw-tooth surface facing the curb. Where the slopes would be too steep if the sides of the alley paving were brought up to the sidewalk level, it is now the custom to form a step of 3 to 7 in. at this place. These methods are shown in the accompanying drawing.

At some alley returns where slipperiness has caused trouble in wet and cold weather, the owners of adjacent property have nailed on the wood paving, strips of corrugated anti-slip metal (such as is used for steps). In a few cases these strips have been placed also on the street paving near the curb at crosswalks. This is done by the property owners at their own expense and apparently without permits from the Department of Public Works.

Pile-Pulling Tackle of High Power

High-powered tackle for pulling piles is used by the Louisville Gas and Electric Co. in connection with its power-house extension work at the foot of North 3rd St., Louisville, Ky. Steel sheeting spliced to make 60- to 75-ft. lengths forms the cofferdam wall for the trench for the condenser intake and discharge tunnels.

The sheeting drives very hard and requires correspondingly large pulling force to take it out. The rig built for this purpose by the company's construction department consists of a two-post frame with wire-rope pulling tackle of unusually high multiplication. The main tackle is 17-part, using ⅞-in. "Hercules" steel cable having a breaking strength of 30 tons. This cable was parted several times during the work. H. H. Fisher, Construction Superintendent, states that the pull required to take out a pile certainly exceeds 300 tons. The seventeen-part tackle is reaved through eight-sheave blocks, and for especially heavy pulling is helped by a three-sheave block and seven-part line connected between the becket and lower block. This rigging gives a travel of 120 ft. of cable to 1 ft. of main-block travel. The hoisting engine is 10x12 and geared to pull 6 tons on a single line.

The attachment to the pile is made by a pair of pin jaws fastened by one 3-in. bolt and two 3-in. pins, the three holes in the pile being in tandem. The holes usually deform enough in hard pulling to distribute the pull among the three pins. The supporting frame has 12x16-in. legs 48 ft. long, which is just sufficient for pulling a 40-ft. sheetpile clear.

Removing Coenties Reef from the East River, New York Harbor

By Edward H. Dion*

Coenties Reef, which is the name of a rock ledge about 600 ft. off the outer end of Pier 6, East River, in the Borough of Manhattan, is now in the course of removal. The United States Government appropriated sufficient money to take out material to a depth of 35 ft. below mean low water, and the City of New York has appropriated another amount, so as to increase this depth 5 ft., thus giving a 40-ft. unobstructed channel here, the adjoining waters already having this depth.

This reef is 600 ft. long and 300 ft. wide at its outermost points. The Government borings show a depth of from 25 to 32 ft. below mean low water. As none of the blasted area has been dredged, the rock formation is unknown; but it is probably gneiss. It has a covering of mud and sand on the deep area and clean rock on the shallow portion, due to scouring by the strong tides. Part of this reef was removed in 1875, to a depth of 25 ft., but broken rock left over from this job is occasionally struck.

Two of the subway tubes leading from Whitehall St., Manhattan, to Montague St., Brooklyn, now under construction, pass through this ledge. The top of the heading is at an elevation of 64 ft. below mean low water, and blasting is going on at the present time at a point

*Great Lakes Dredge and Dock Co., 17 Battery Place, New York City.

directly underneath the drill boat used by the contractor. The blasting and drilling are heard by the tunnel workers, and a very distinct shock is felt on board the drill boat when tunnel blasting is done.

The current has a velocity of from 4½ to 5 mi. per hr., and there is a tidal range of about 5.5 ft. This strong current necessitates a very secure anchorage and a close watch of the boat spuds. Moves, after the completion of a row of holes, are often delayed until slack water, because of the fear of being carried away. Traffic at this point is very heavy; consequently, the Secretary of War has restricted a buoyed area, to safeguard against accident due to the upheaval of rock, broken drill bars that project above this rock, and to protect the contractor's floating plants.

Work was started on June 9, 1916, and at the present time about three-eighths of the area has been blasted. One 5-drill frame machine is being used, operations being carried on in three 8-hr. shifts. The drill machines are Ingersoll-Rand, rock, subaqueous, known as H-64 and K-64 types. The drill bars are 55 ft. long, made up of soft-steel stock and tool-steel bits. Drilling is done to an overdepth of 5 ft.—that is, to a 45-ft. plane below mean low water. From experience derived on former rock work, this depth is thought to be sufficient to acquire the desired dredging depth to grade.

The longitudinal center line of the reef runs in a north and south line, and it was at first proposed to move the drill boat 5 ft. along this line each time, and then the entire reef would be covered in two cuts. As the current takes a sweep at this point, striking the boat broadside, the floating débris caused a lot of trouble to the drills. The force with which some timbers hit them was sufficient to cause bad bends and consequently much lost time in changing bars. Difficulty was also experienced in making moves after a row of holes had been completed, due to the water piling up on either side, depending on ebb or flood tides. After a couple of weeks' trial the position was changed to a move diagonally across, thus bringing the current on the head ends. This method has been used since with success.

In order to reduce drill-bar troubles, cast-iron pipes of decreasing diameters were attached together by steel bands forming a collapsible pipe, which can be raised when moving the boat. A cross-pipe is fitted at the lower end, to permit the drillings to wash out. The pipe is suspended from the drill frame by steel leaders, and is known as a sand pipe. Bent bars have been practically eliminated by this scheme.

After a move, the location of the drill boat is determined by shore ranges, which consist of targets and points on prominent buildings. The plotted locations have been checked by transit intersections, and the error rarely exceeds 2 ft. The sand pipes are next lowered, until they rest on the bottom.

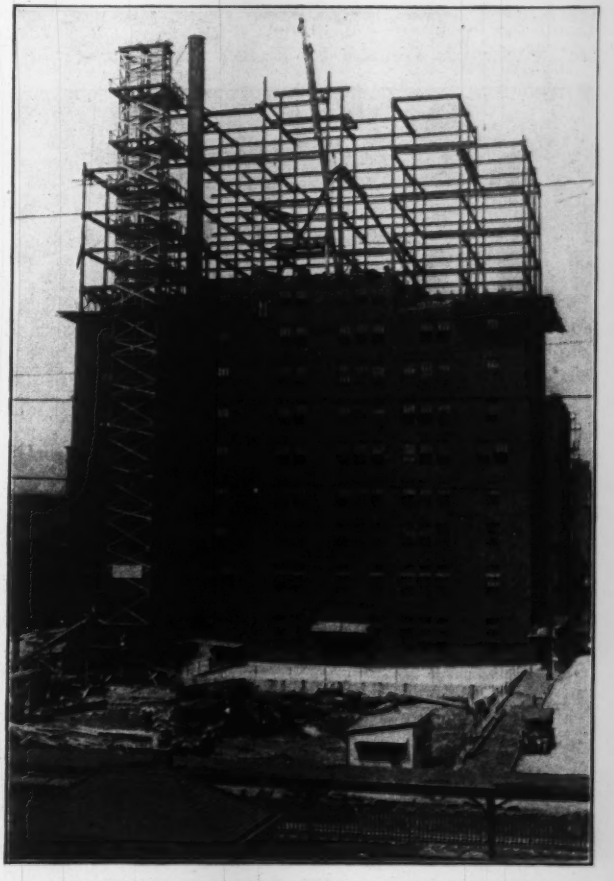
The drill bars passing through the sand pipe are started and driven to rock. The elevation is noted, and drilling continued to the 45-ft. plane. The drill is then pulled out and lowered again, this operation being repeated until the hole is clean. A charger pipe suspended from the drill frame is then lowered to the deck, where the blasters insert the dynamite. This pipe has a slit along the side, the sticks of dynamite are put in from the bottom, the last two containing the exploders. The wires are held on deck while the pipe is lowered in the sand pipe. Rammers tamp the charge to the bottom of the drilled hole, and the charger pipe is then raised. The charges are set off by machine. One hole is fired at a time, and the boat is not moved away from its position, the surface water being hardly disturbed.

Each drill frame has four holes on each move, and is capable of an overlap of one hole on either side. As the rock is very hard and subway operations demand caution, heavy charges cannot be used; therefore, holes are drilled on 5x6.3-ft. spacings. This permits 20 holes to be drilled per move. The time required to drill holes varies greatly, shallow ones often taking longer than the deepest ones. Seams are frequently struck, causing sticking, which is one of the greatest troubles encountered. Holes after completion sometimes refill with sand or with pieces of broken rock and are very troublesome to clean. From all indications, including the examination of a diver, the rock is well shattered.

The number of feet drilled by night shifts bears a very good comparison to the day work; and as the only additional cost to running the plant is lighting, an even distribution of cost of operation for 24 hr. is regarded as just.

Adding Five Stories to an Eight-Story Office Building in Pittsburgh

An extension of five stories—planned at the time the structure was erected to its original height of eight stories—has just been added to the Jones & Laughlin Steel Co. office building in Pittsburgh. In the original



ADDING FIVE STORIES TO AN OFFICE BUILDING

construction the floorbeams of the ninth floor had been put in place and used to support a temporary roof, and the columns had been provided with splices to take the future extensions. When the addition was begun, holes were cut through the roof to enter the columns, and then these holes were housed around to keep out the rain. A stiffleg derrick hoisted the steel and then erected it.

To give access to the portion of the floor lying between the stifflegs, the loads were temporarily landed at the extreme swing of the boom. The boom was then passed back of a disconnected stiffleg and proceeded with the erection after the stiffleg had been replaced.

The old roof was wrecked as soon as the tenth-floor slabs and the new side walls of the ninth floor were in place. The floor was maintained in a fairly water-tight condition. It had originally been intended to require that the new roof be placed before the old was removed.

All materials other than steelwork, including concrete and débris from the old roof and cornice, were handled in the construction elevator at the rear of the building. Floors were built on the Witherow system, with removable steel centers on which were cast a beam-and-slab floor framing into the steel floorbeams.

McClure & Spahr were the architects, and James L. Stuart was the contractor.

Concreting the Footings and Piers of a Viaduct 196 Ft. High

Foundations for what will be the highest track structure on the Southern Ry. are now being put in near Toccoa, Ga., on the 50-mi. relocation now about 50% complete. This structure is a double-track steel viaduct at station 7980-59 (from Charlotte, N. C.), 196 ft. high and 1,000 ft. long.

As originally designed, the viaduct was to consist of girders carried on concrete abutments, two hollow square concrete piers and six steel towers 180 ft. high. The spans from south to north (toward Charlotte) were to be as follows: 100 ft. 6 in., 113 ft. 4 in., 93 ft. 2 in., five spans 80 ft. each, 93 ft. 2 in., 113 ft. 4 in., 100 ft. 4 in., 100 ft. 6 in. After the concreting plant for such a structure had been practically installed, the design of the viaduct was changed to all 100-ft. spans between hollow towers of concrete having circular interiors and rectangular exteriors, and spaced 128 ft. c. to c. The purpose of this article is to describe the concreting plant as originally laid out to take care of the abutments, two concrete piers and the footings for the six steel towers. It will be enlarged to supply the increased amount of concrete now required.

The North Broad viaduct crosses a valley 2,000 ft. wide between precipitous hills about 110 ft. high. The present railway line rounds the hill bounding the valley on the north. Here a short spur has been extended over some material bins, shown in Fig. 2. The bin at the extreme right contains coal. The others are for sand and cement. These bins discharge into narrow-gage cars underneath.

The material trains run across the valley to the foot of the south hill, where a cement house is located. From this point an inclined cable tramway 500 ft. long ascends on a 45% grade to the concrete plant at the top of the hill. The car on the cable track is simply a frame formed of two longitudinal stringers and two crosspieces, carried on four wheels. This tramway is shown in Fig. 1. Alongside the tramway at the top are located the cement house and space for sand and broken stone stor-

FIGS. 1 TO 3. CONCRETING THE FOOTINGS FOR HIGH VIADUCT ON SOUTHERN RY., TOCCOA, GA.
Fig. 1—Incline to plant. Fig. 2—Bins at railway. Fig. 3—Quarry

FIG. 1. SHOWING STEAM-SHOVEL MACHINERY ANCHORED ON A HULL

age. The stone is brought in on a short trestle carrying a narrow-gage track leading from the quarry (Fig. 3), which is about 1000 ft. south of the mixer and on the right-of-way of the new railway line. The stone is dumped off the trestle onto a storage pile and lifted by a bucket conveyor to the crusher, which delivers within reach of the mixer. In front of the sand pile and a few feet below it is the concrete mixer, delivering to the various footing forms by a cableway about 2000 ft. long, the towers of which are on opposite banks of the valley.

The North Broad viaduct is on the contract section worked by C. W. Lane & Co., of Atlanta, and is being erected by that company.

Dredging with Steam-Shovel Equipment Mounted on a Hull

On canal clean-up work at Trenton, N. J., the Pennsylvania R.R. is using a very unusual sort of dredge, consisting of the machinery of a small revolving steam shovel mounted on a wooden hull. The boom and dipper handle are especially long, making it possible to dig to a depth of 9 ft. below water and dump material 28 ft. from the centerline of the boat and 6 ft. above water. The hull is 40x18½ ft. in plan by 4½ ft. deep. The outfit is efficient for digging small ditches or for dredging shallow streams. It is cheaper to build than a regular dredge for the same service and is much cheaper to operate. The shovel used is of the Osgood 18 type.

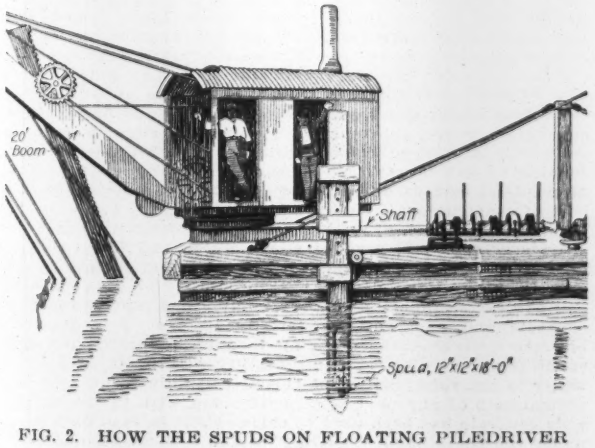


FIG. 2. HOW THE SPUDS ON FLOATING PILEDRIVER ARE OPERATED

The truck frame of the shovel—axle and axle bearings removed—is bolted to the hull. The heavy end-plate is bolted both to the shovel frame and (by means of an extension plate) to the hull.

The special parts required to build this outfit are the spuds, spud machinery, backing drum at the foot of the boom, and the hull upon which the machinery is mounted. The general arrangement is shown in Fig. 1, while Fig. 2 shows exactly how the spuds are operated.

To move the dredge forward: First, the dipper is placed far ahead; next, the hull is floated by raising the spuds; then, by starting the boom engines, the hull is caused to move toward the dipper. The spuds are then dropped, thus anchoring the hull, when the dredge is again ready to excavate.

FINE AGGREGATE

Eccentric Loading of Columns—The question of when and how eccentric loading is to be taken account of in proportioning the columns of buildings is raised by H. G. W. Inasmuch as sound engineering and most building ordinances require due account to be taken of eccentricity, it is important to know in what case the load applied by beam connections is an eccentric load. But H. G. W. says: "I understand from people connected with bridge-shop offices that it is customary to disregard eccentricity except where the beams are bracketed far out, as at crane girders. Wall girders of ordinary buildings ought to be eccentric in the same way. What is the practice in this matter among responsible engineers?"

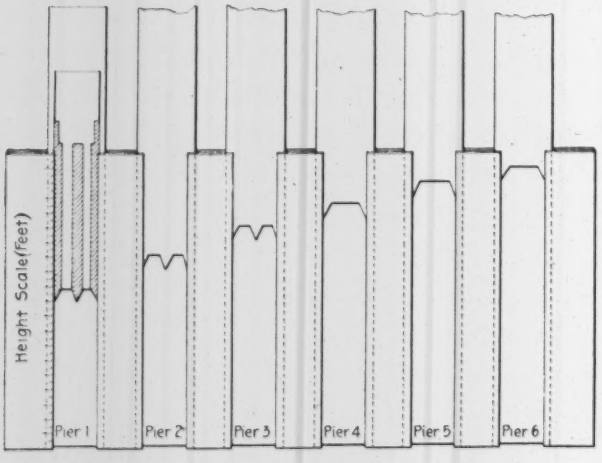
Northwestern Arc of Primary Triangulation Completed—The United States Coast and Geodetic Survey has completed the observing of an arc of primary triangulation which extends 630 mi. from northern Utah northwestward to the Columbia River in northeastern Oregon, thence westward down the Columbia River to Portland, Ore. About 100 stations have had latitudes and longitudes accurately determined; and as these points have been substantially monumented, they will be available for starting points of Federal, state, boundary and other surveys and engineering works. As soon as the office computations can be made at the Washington headquarters of the Coast and Geodetic Survey, the data for this survey will be published. The party, under C. V. Hodgson, making this survey used for the first time automobile trucks on primary triangulation, and the trucks proved so successful

that all other surveying parties engaged on similar work will use this means of communication. The trucks carried the party and outfit to the base of the peaks on which observations were made. The camp equipage and instruments were carried from the truck to the top of the peak by horses or by members of the party. Accurate elevations of numerous mountain peaks were determined by this survey. Most of the observations were made at night by use of acetylene lamps. The longest distance observed was 134 mi. between a peak in northern Utah and a second peak in southern Idaho. The lamps were cared for by trained light keepers.—Bulletin of United States Coast and Geodetic Survey.

Cement That Cost as Much as Flour—Hauling cement barrels by caterpillar tractor across the desert is shown in the accompanying view. The hauling was done for the Gem Lake and Agnew dams for the Pacific Power Corporation. These dams, as described in "Engineering News," Dec. 21, 1916, p. 1157, are located in the upper levels of the Sierra Nevada Mountains and are 60 mi. from the nearest railway station. The materials had to be brought in by caterpillar tractor, tramway, lake barges and tramway, which brought the cost of cement at the site up to $7.50 per bbl.

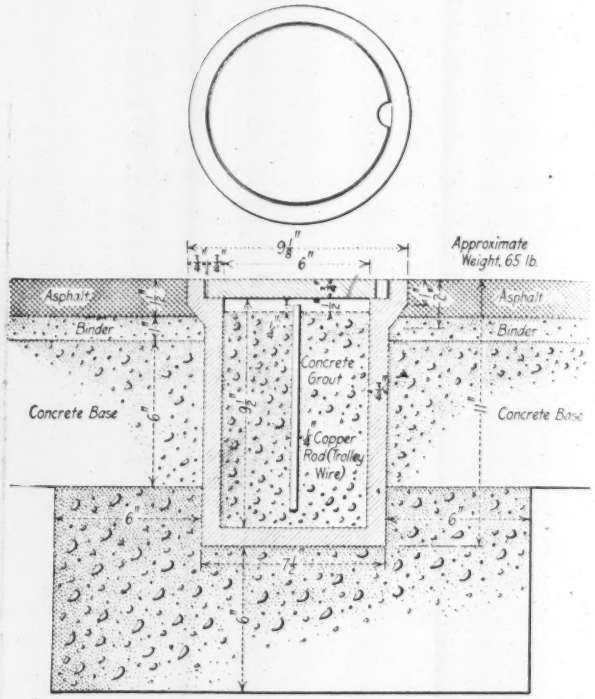
CATERPILLAR TRACTOR HAULS CEMENT ACROSS DESERT

A Novel Progress Chart for Bridge-Pier Sinking is used by P. B. Spencer, Division Engineer of Construction for the New York, New Haven & Hartford R.R., in charge of the construction of the new Thames River bridge of that railway. Holbrook, Cabot & Rollins are the contractors. The chart is really a mechanical device similar to a slide rule with six slides, one for each of the six sinking units of the bridge substructure. The slides are of stiff cardboard, retained in slide-chases formed of cardboard strips glued over filler or spacer strips to a back or body. The whole device, hung on the wall, gives a comprehensive picture of the condition of progress. There are height scales on the retainer strips, and on each slide is drawn an outline of the pier box structure which is shaded with colored crayons to describe the progress of timbering and of concreting. The sketch suggests the general appearance and arrangement of the chart.



PROGRESS CHART TO KEEP TRACK OF BRIDGE-PIER SINKING

Street-Intersection Monuments—In the recent extensive asphalt-paving work at Vincennes, Ind., the resetting of the monuments at street intersections was given careful attention. The former monuments were of limestone, 8x8x30 in., centered by a crossmark on the top. The new type is a cast-iron cylindrical box 7½ in. in outside diameter and 11 in. deep over all, with a flanged top for the cover. This box is set in approximate position when the foundation is laid. As soon as this is completed, the casting is centered with a transit, and the center lines of the streets are cut on the top. A ¼-in. copper rod is then set in concrete grout within the box and adjusted to the exact center. It is found best to center the monuments before the top coat is laid, on account of liability of error in setting the castings. This monument was designed by H. T. Watts, City Engineer.



NEW MONUMENT FOR STREET INTERSECTIONS AT VINCENNES, IND.

Concrete Made with Silicate of Soda is suitable for pavement foundations, according to a paper by George C. Warren, President of Warren Brothers Co., Boston, Mass., read before the engineering section of the American Association for the Advancement of Science, Dec. 28. He said: "During the past year the laboratory of the Warren Brothers Co. has done a great deal of work investigating the use of silicate of soda as the cementing material for concrete foundations and finds that in connection with a substantial waterproof bituminous wearing surface it is quite practicable to make a high-grade concrete foundation in this way. The question is one of relative prices of portland cement and silicate of soda and consequent first cost of construction. We have also successfully laid approximately 10,000 sq.yd. of wearing surface over concrete made of silicate of soda and crushed stone, which had failed to successfully withstand vehicular traffic as a road surface in Cos Cob, Conn., and Sudbury, Ont. The silicate of soda concrete has greater resiliency and less rigidity than portland-cement concrete and apparently materially lessens, if it does not entirely overcome, the cracking troubles of portland-cement concrete foundations." The solubility of silicate of soda in water is not referred to, but this is certainly a factor in the permanence of any pavement constructed with it. Silicate of soda concrete has been used to some extent in road pavements under the trade name "Rocmac," which is a mixture containing also sugar, powdered limestone and other ingredients.

Editorials

Horizontal Fire Exits To Safeguard New York Hospital Patients

Every engineer and every official responsible for the design or maintenance of buildings housing large numbers of people ought thoroughly to understand the great advantage that horizontal exits have over the ordinary vertical fire escapes to safeguard life in case of fire. The value of horizontal escapes and the defects of vertical fire escapes were first clearly recognized and stated by H. F. J. Porter, Consulting Engineer, in a paper read in 1913 at the Baltimore meeting of the American Society of Mechanical Engineers.[1] *Engineering News* was the first among technical journals to recognize and call attention to the great importance of the principles laid down in Mr. Porter's paper.

As some of our readers will recall, Mr. Porter demonstrated by figures based on actual experiments the utter inadequacy of the ordinary outside metal fire escapes or even of ordinary stairways to furnish sufficiently rapid egress for the crowds contained in many present-day buildings, in case of the rapid spread of fire. The horizontal exits that Mr. Porter advocated are provided by carrying a fireproof partition wall from the cellar to the roof with doorways at each floor, closed by fireproof doors. If a fire occurs on any floor, those threatened by it can quickly pass through the doorway to the other side of the firewall, and the door is closed behind them.

Not only is this simple method of safeguarding life of great value in connection with factories, loft buildings, schools, department stores and other buildings used by great numbers of people, but it offers for the first time a means of safeguarding the lives of the helpless inmates of hospitals, almshouses and other institutions. It would be impossible in most cases to carry helpless, bed-ridden patients in any considerable number down long flights of stairs in time to save them from the rapid spread of flames; but with the horizontal exits the beds with the patients in them can be rapidly wheeled through the open doorway to safety on the other side.

Elsewhere in this issue is described the work carried out by direction of the late M. J. Drummond, when Commissioner of Charities of New York City, under which the city hospitals, almshouses and other buildings of the Department of Charities, most of them not fireproof, have been so remodeled by the provision of firewalls and horizontal exits that their 17,000 inmates are safeguarded from the dangers of fire.

Of course, to carry out the horizontal-exit idea in the ideal manner, the firewalls should be located and constructed when the building is erected. In this case the cost would be trifling compared with the ordinary plan of providing vertical fire escapes. In the buildings of the New York Charities Department, however, it was found possible in nearly all cases to utilize existing partitions so that the entire cost of establishing horizontal exits in the 206 buildings of the Charities Department was only $117,000.

The good example set by New York City ought to be followed by every city in the country. Here is an opportunity for engineers to render a real public service by urging upon public authorities the duty of giving protection to the helpless inmates of public institutions against a horrible death by fire. This plan of protection against the dangers of fire, if followed there, moreover, will gain a wide publicity that should lead to its adoption for other types of buildings and eventually put an end to the disgraceful and needless holocausts that have occurred so frequently in the United States during the past dozen years.

[1] "Engineering News," July 31, 1913, pp. 224, 228.

America's Part in Rebuilding Europe

Many of those who endeavor to forecast the condition of American industry and finance in the period following the conclusion of peace appear to have fixed their attention solely on the stoppage of the demand for war supplies. But when it is no longer necessary for Europe to draw on America to supply her troops in the field, she will still find it necessary to buy from America vast quantities of goods to repair the devastation wrought by the war and to put her farms and factories on a working basis.

A commission of twelve prominent engineers and businessmen was sent to France last fall by the American Manufacturing Export Association to ascertain the extent to which American enterprise and industry would be called upon to help restore the devastated portions of France after the war. One of the members of this commission, Noble F. Hoggson, describes in *System* for January some of the results of the commission's investigation. He reports that the value of the property destroyed in northern France alone is in excess of 2½ billion dollars. No less than 753 cities and towns have been partly or wholly wiped out. The total number of buildings damaged or destroyed is given as over 46,000.

On the farms of France, it is estimated that one-half the horses and oxen heretofore used for draft purposes have been killed in consequence of the war. The scarcity of labor, also, as a result of the many men killed and incapacitated by the war, will make necessary the use of farm machinery on a scale hitherto unknown. The French manufactories of farm implements have been converted into munition plants, and to restore her agriculture, France must draw heavily on other countries for agricultural machinery and tools. Many of the French industrial plants outside the war zone will need new tools of modern type, as their equipment prior to the war was antiquated and cannot survive the new conditions of increased labor cost. The French people also look forward to a great revival of travel when the war is over and estimate that nearly $100,000,000 must be expended

in building additional hotels to care for tourists. Material and equipment for these must largely be imported.

These are the conditions in France alone. In other countries also—in Russia, in Italy, in Belgium and even in the neutral countries—the demand for foreign materials and goods, when once the barriers on international trade are removed, are bound to be enormous.

The limit to this demand, obviously, will be the ability to raise the money to pay for these goods. With peace once reëstablished, however, each nation will without doubt extend almost unlimited credit in order to meet the urgent necessities of its people. There can be little doubt also that, with peace once reëstablished, vast amounts of capital in the United States and in other countries, which is withheld from foreign investment while the outcome of the war is uncertain, will be unlocked and available for restoration purposes.

The Narrow-Gage Delusion

Was there ever a scientific fallacy that caused the waste of so many millions of dollars as the idea that the cost of constructing a railway varies directly with the gage of its track? It was this fallacious idea that formed the foundation of the narrow-gage railway craze that started a half-century or so ago and misled many engineers as well as the general public. Probably many of those who originally promoted narrow-gage railway construction, while not so ignorant as to believe in this fallacy themselves, shrewdly perceived that the public could be made to accept this idea and consequently could be induced to invest its money in building narrow-gage roads in the belief that the roads would be built so cheaply that they would be profitable.

In the United States the fallacy that the narrow-gage railway is cheap to build and to operate has been so thoroughly demonstrated that narrow-gage railway construction has practically ceased. In foreign countries, however, the narrow-gage fallacy still persists. The Panama government completed last year a narrow-gage railway 57 mi. in length, extending from the coast inland in the province of Chiriqui. The road has heavy grades, up to 5%, but the curvature is not excessive. On several divisions the maximum curve is only 5° to 6°, and on the division of the most crooked alignment the maximum curvature is only 12°. In a paper describing the construction of this road by A. F. Zinn, its Chief Engineer, read before the Western Society of Engineers on Nov. 6, Mr. Zinn said:

> The saving in cost in construction and equipment of a narrow-gage railroad compared with a standard gage is not as great as many engineers believe. The principal saving is in the cost of ties, ballast, excavation and bridges, the total saving being approximately only 6%.

This difference in first cost of construction will be fully offset by the lower cost of maintenance of a standard-gage track on any line free from sharp curvature and carrying any considerable traffic. The narrow-gage track, especially where heavy equipment is run over it, will not stand the neglect in maintenance that a standard-gage track will, for low spots in the rail are sure to cause serious lurching and rapidly grow worse. Further than this, where money must be economized in construction and equipment, it is usually possible to buy second-hand standard-gage rolling stock of light weight in fair condition at lower cost than for special narrow-gage equipment.

About the only location where the construction of a narrow-gage line can be justified on grounds of economy is in very rough, mountainous country, where extremely sharp curvature is necessary to reduce construction cost. There are probably places of this sort where the construction of a narrow-gage road can be successfully defended. Such roads, however, form a very small percentage of the mileage of narrow-gage railways.

If the engineer engaged in railway construction in the newer countries of the world can make his clients understand that the first cost of railway construction is dependent on the weight of the rolling stock used and not on the gage of the track, he may by this one accomplishment alone save many times his salary.

Piling Up Public Debts

The City of Toronto, Ont., in 1905 had a "permanent" debt of $24,000,000. At the close of 1915 this debt had increased to over $86,000,000. Public works now under way for which bonds will have to be issued will raise this amount to $109,000,000, according to a report recently presented to the Toronto authorities by T. Bradshaw, the Commissioner in charge of the city's finances.

In addition to this amount, other public works are in contemplation and not yet financed which will cost over $21,000,000. The city has heavy obligations to meet in connection with the charges on the municipal hydro-electric system and insurance on the lives of its citizen soldiers. The interest and sinking-fund charges on the city's debt amounted in 1915 to $5,795,000, and Commissioner Bradshaw says there is a certainty of a further heavy increase during the next year or two, when the works now being paid for by temporary financing have bonds issued on their account. The population of Toronto is about 450,000 and is not increasing at the present time, while the tax assessment is practically stationary. With the population of 450,000, it will require an annual payment of $13.50 per capita to meet annual debt charges of $6,000,000. Inasmuch as a high rate of interest must be paid on all bonds issued at the present time, it is probable that the annual debt charges will considerably exceed even this large amount. In view of the conditions above set forth, Mr. Bradshaw says:

> We have reached a condition in our affairs which demands that we resolutely refuse to embark upon any new enterprise. The City of Toronto will have to decide within the next few years what it shall do in connection with the taking over of several utility enterprises. It would be no less than a catastrophe if we found ourselves financially unable to handle them in a manner which would be in the best interests of the city and its taxpayers. Again, it is a well-known fact that at present labor, material and capital are very dear. The cost of new work is almost double what it would be under normal conditions. Are we justified, therefore, in prosecuting new work and services at such a period? Another question which should receive serious consideration is, What preparation are we making for the employment of our citizen soldiers when they return home? It is essential that we conserve our energies and our resources now so that we may be prepared for that which may be expected of us in the future.

The financial condition of Toronto is unfortunately typical of that of a considerable number of other cities in the United States and Canada. It may be granted indeed that these burdens of municipal debt seem modest compared with those under which the belligerent nations of Europe must hereafter struggle; but they are surely serious enough to emphasize the wisdom of the warning which Commissioner Bradshaw sounds, and which gives

sound advice for many other cities to heed even though their load of debt is not so pressing.

In searching for a cause for the unfortunate financial condition in which so many cities now find themselves, there is a world of meaning in one word used by Commissioner Bradshaw in his report, where he characterizes certain obligations of the city as a "permanent" debt. What good reason can be given why a city should have such a thing as a "permanent" debt any more than an individual or a business firm should? Doubtless Commissioner Bradshaw used the term to signify the debt represented by long-time bonds compared with floating indebtedness; but unfortunately most American cities have a very large amount of permanent debt outstanding, which is "permanent" in the sense that there are no tangible assets now existing to offset the debt. The money was spent for pavements which have been worn out and torn up; for buildings which have become obsolete and have been torn down; or it was merely borrowed to pay deficits in the current running expenses of the city.

There is no remedy for such financial crimes of the past, but it is at least the course of wisdom to see that similar crimes are not repeated in the future. The foundation principle of sound finance is that the city should not borrow money to pay for any piece of work without making provision that the loan will be all repaid, interest and principal, during the life of the work.

A reason why it is especially important to emphasize this warning at the present time, is that cities everywhere are likely to embark during the next decade on the ownership and operation of public utilities which have heretofore been in the hands of private companies. One of the greatest dangers to municipal finance is that in operating such utilities there is always a strong tendency to reduce the rates charged below what is necessary to maintain the city in sound financial condition.

With a municipally owned water-works, for example, there is always a strong tendency to reduce rates to water users on the ground that such a measure is popular with the voters; or to give free water for a term of years to new manufacturing industries on the ground that this will help to boom the city; or to burden the water-works with the supply of water to public buildings and for the use of the fire department, even though there may be large bond issues outstanding and more water revenue is needed to pay them off.

The cities which have attempted to own and operate municipal docks have found that constant pressure is brought to bear to reduce the rentals or other charges below the point that makes the investment profitable to the city, on the ground that it is necessary to retain business in the city and prevent its being driven elsewhere. Most of the municipal electric-lighting plants are charging a far lower rate than is charged by the corporations.

The steady increase in municipal debt should compel an attention to these matters in the future that has not been given in the past. Cities everywhere are up against the problem of raising additional revenue to meet their necessary expenses and to carry on the various additional activities which public opinion all the time demands. The general property tax has by common consent about reached its limit as a means of raising revenue. Cities will be compelled, therefore, to adopt the policy of carrying on the public utilities in their control on a basis that will yield a profit to the city treasury instead of a deficit.

Waste-Material Disposal at New York

Few people realize what a vast amount of waste material is disposed of annually at New York City by being placed on board scows and carried out to deep water in the ocean. The annual report of the Chief of Engineers states that in the 16 years from 1890 to June 30, 1916, a total of 160,313,000 cu.yd. of waste material has been deposited at New York City. This is roughly about twice as large a volume as the entire amount of material excavated for the Panama Canal. The amount of material handled at New York last year was 20,800,000 cu.yd.

Prior to 1888 there was no law regulating the dumping of material in New York harbor and adjacent waters. Those who disposed of street sweepings, dredgings, etc., often dumped them in the navigable channels, from which they had later to be dredged. Since 1890 the deposit of waste materials has been under supervision of the Engineer Department, which uses a fleet of five vessels in its work. This supervision has cost over $2,000,000 in the 16 years since it was established. The necessity of the work is apparent, since this vast volume of material, if allowed to be deposited in the navigable waters of the harbor, would very rapidly cause shoaling. A simple computation shows that if the 160,000,000 cu. yd. were equally deposited to a depth of 6 ft., it would cover an area of nearly 80 square miles. The official report says:

> Experience has shown that any relaxation of a strict patrol is sure to result in injuring the channel by illegal dumping. Enormous amounts of material are daily carried to sea by people who have little hesitation of dumping anywhere, if they are not watched. The distance to the point of disposition varies from 25 to 40 miles, and the character of the material is a powerful incentive to get rid of it as quickly and with as little expense as possible.

It is to be regretted that a larger amount of this material is not used for filling in shallow waters and tidal swamps in and near the metropolitan district, where it would serve a useful purpose instead of being wholly wasted by dumping at sea. About a quarter of the material deposited since 1890 has been used for shore filling, but the proportion ought to be largely increased. This is especially true of street sweepings, ashes and rubbish, which contain a good deal of floating material that often causes more or less nuisance on adjacent beaches when dumped at sea.

Doubtless a much larger amount of material would be used for filling in land if more economical means were available of unloading material from the scows and transporting it over the area to be filled. If this part of the work could be done at low cost, the opportunities for land reclamation over the enormous areas of shallow water and swamp land about New York City would make it profitable to use the material in that way.

The critical portion of the Miami flood-protection engineering, the design of the great earth dams and the means for passing a limited flow will be dealt with in our next issue, Jan. 25. This part of the design problem had to face an extreme degree of fear of dams among the inhabitants of the valley and most formidable difficulties of a technical nature. The solution worked out must be ranked as a classic in the field of water storage and control.

Letters to the Editor

Absurdly Low Salaries Paid Detroit's Engineering Employees

Sir—Your editorial "Do Engineers Need to Eat?" touches a point which is secondary to the main purpose of the report of the Detroit Bureau of Governmental Research on Detroit's sewer construction—namely, to raise the standard of sewer construction in Detroit. However, the old question of compensation is always with us and is always interesting, and I hope that your editorial will reopen a discussion which will break away from beaten paths and result in tangible benefit to the engineering profession.

In place of the caption "Do Engineers Need to Eat?" one more to the point would be "Are Rodmen Engineers?" Not "Should Rodmen Be Engineers?" but "Are Rodmen Engineers?" As a general proposition rodmen are not engineers. In our opinion rodmen should be engineers—embryo engineers. Preferably, they should be inexperienced technical graduates. A graduate with one or more years' experience prior to graduation will be an instrumentman or better, as the amount and kind of his experience warrants. The position of rodman should be the first step in the line of experience and promotion.

But the inexperienced technical graduate, at first probably will be no better than an able-bodied laborer. His investment in technical education cuts no figure at this point in the game, and for services rendered he certainly is worth no more than the laborer. He is serving his apprenticeship; and if he is satisfied to remain indefinitely as a rodman, he ceases to be an embryo engineer, becomes merely a rodman, and the laborer who rates his task as a good job is just as good, perhaps better. Your comparison, therefore, of the rodman's monthly compensation with day-labor wages is to the point. If the figures used prove anything, they prove that $85 per month as compensation for rodmen is about right, perhaps a little high, because usually it is a steady job.

Parenthetically, we would note that the minimum wage at the Ford automobile plant is $5 per day only after six months' probation. Prior to Oct. 10, 1916, two rates for unskilled labor were in effect—34c. and 38c. per hr. Since that date, due to the increased cost of living, the hourly rate has been raised to 43c., or for an 8-hr. day $3.44 for employees over 18 years of age. Children are not employed at the plant.

The report quoted also states: "The salary of the sewer engineer—$2000 per yr.—is altogether too small for the responsibilities involved." Think of it! A rodman at $1200, and the engineer in charge of contract sewer construction at $2000 per year!

For the sake of a concrete example, let us give more Detroit figures. A tabulation showing the positions in the Department of Public Works receiving above $2000 per yr. is:

Commissioner	$7,500
Secretary	3,200
City engineer	4,000
Principal assistant city engineer	2,700
Asphalt expert	3,700
Superintendent of paving	2,800
Superintendent of paving	2,600
Superintendent of street cleaning	2,800
Superintendent of sewer maintenance	2,800

These are the salaries of the men administering the affairs of a department with a $6,000,000 yearly budget for a rapidly growing city, with a present population of 750,000. Is not the profession of engineering cheapened by such salaries? A salary of $7500 for the head of this department may appear big to engineers, but not to businessmen, who do big things in a big way and at the same time know the value in dollars in services rendered. A salary of $4000 for the city engineer may satisfy some engineers, though we doubt this. But as compensation for the head of the technical bureau of a booming city like Detroit, confronted with immense problems in transportation, sewerage, paving and all aspects of city planning, this amount is not only ridiculous, but pitiful.

Centering fire on the compensation of rodmen is misdirected effort. First, let us employ embryo engineers as rodmen. Then broken-down barbers, bookkeepers, retired bar tenders, would-be politicians and relatives of politicians, as rodmen and inspectors, will disappear from our municipal-engineering payrolls. Gradually, the engineering personnel of our municipal department will change complexion, and the question of compensation will be adjusted.

Compensation depends primarily upon two factors—the requirements of the position and the caliber of the man occupying the position. Theoretically, the first factor only should count, because theoretically the incumbent should meet at least the minimum requirements of the position. But in practice the caliber of the man occupying the position is considered. For this reason, while many of our city officials and employees may be overpaid, the positions they occupy, but do not always fill, are often grossly underpaid.

Observation indicates that businessmen of vision, who of late years are more frequently found on our public-improvement commissions, are the best friends of the engineer in so far as compensation is concerned. Such men value the services of the engineer, while at the same time the engineer places a low figure on his own services. Let us value our services as professional men, but first, let us look to the personnel of the engineering profession, starting with the rodmen.

Technical journals as mediums of publicity can help in this matter, but success depends on the engineers themselves and, in municipal work, primarily on city engineers and heads of public-works departments. Bureaus of municipal research are ready to help; in fact, are helping, because in their quest for economy and efficiency they recognize that the secret of efficiency and true economy is to secure the best man for the job and pay him well for it. H. S. MORSE.

Detroit, Mich., Dec. 29, 1916.

[All of the fire of the editorial under discussion was not centered on the salaries of rodmen; indeed, that was merely incidental. Among the more important statements in the report was that a salary of $1400 was too much for a leveler and that $1500 for a chief of party, while justifiable in this case, was a little extravagant. That the salary of the sewer engineer is too low is no excuse for making all other salaries low in proportion. It is a pity that Mr. Morse did not express the same sentiments in the report that he has in the letter above.—Editor.]

Ornament and Art in Bridges

Sir—If it is the intention to spend $60,000 on bridge decoration, Pittsburgh may with advantage look over what Paris has done along this line. To nail a few bronze plaques and rosettes on latticed bridge members and say "the result expected is artistic value and educational effect" ("Engineering News," Dec. 28, 1916, p. 1243) is to ignore Ruskin's comments on appliqué work. I am aware that quoting Ruskin to an architect is like shaking a red rag at a bull, but to some of us who react feebly to the stimulus of architecture in its various and at times wonderful manifestations he is informing.

The architects tell us that a bridge truss is not a thing of beauty and lament the fact in a tone that implies guilt on our part rather than structural limitations; the truss does, however, possess character—something which I am led to believe is essential, even in a structure whose keynote is beauty. It is a bit annoying to be convicted of groveling tastes by a man who copies a Greek temple, overtops it by half a dozen stacks, calls it a power house and insists that we admire the result.

EDWIN H. WARNER.

Los Angeles, Calif., Jan. 6, 1917.

Underground Water Unlikely To Give Trouble in the Cascade Tunnel

Sir—I was somewhat surprised to read Frank B. Walker's statement in "Engineering News" of Dec. 21 with reference to the proposed 30-mile tunnel under the Cascade Range. To the layman, one million gallons per day may look like a pretty big drink to absorb, but to the engineer it reads only 1.5 sec.-ft. There are many long tunnels, successfully completed and in operation from two to fifteen years in

which the discharge at one portal amounted to 3 to 44 sec.-ft.—that is, from 2 to 30 times as much as that recorded by Mr. Walker. Underground water is always annoying when driving and especially lining a tunnel, but it is far from being "a serious engineering matter and possibly an actual menace to traffic."

The fact that the proposed tunnel under the Cascade Range passes directly under lakes does not necessarily mean trouble ahead; on the contrary, the very existence of the lakes indicates, to a certain extent, that the underlying rock is more or less impervious. A large inrush of water is more to be feared in limestone or a like formation than in igneous rocks. In driving tunnels at great depth, a wet tunnel is preferable to a dry one, as the rock temperature is always lowered by the presence of water.

There is another feature that should be given due consideration: The proposed 12-mile tunnel from Scenic Hot Springs to Merritt would be located some 1000 ft. higher than the grade of the proposed 30-mile tunnel.

The following are some of the rates of underground-water discharge as recorded in several tunnels:

Name of Tunnel	Materials Penetrated	Length Considered, Ft.	Maximum Discharge, Sec.-Ft.
Granges, north portal	Limestone	13,930	8 5
Granges, south portal	Gypsum, anhydrite	14,163	22 0
Hauenstein	Limestone, shale	19,225	3 3
Weissenstein	Limestone	12,150	15 0
St. Gothard	Granite, mica schist	25,882	8 1
Simplon, north portal	Schist, gneiss	40,790	7 1
Simplon, south portal	Limestone, gneiss	22,900	44 0

EUGENE LAUCHLI.

2 Wall St., New York City, Dec. 27, 1916.

Sir—Frank B. Walker's letter commenting on General Chittenden's article on a proposed 30-mile tunnel under the Cascade Range says, among other things, "Should the 30-mile tunnel ever be constructed, one of the greatest troubles will be the excessive water." As I see the facts, they altogether contravene Mr. Walker's prediction. In the first place, the present tunnel is relatively very near the surface of the ridge which it penetrates, averaging a depth of perhaps 600 ft. with a maximum of about 1,200 ft. This is a superficial depth, and consequently it might be expected that the effects of weathering and of other subaërial influences would have greatly contributed to the creation and enlargement of percolation channels and other avenues for the movement of waters that the tunnel might intercept. In the second place, the present tunnel for its whole length, or nearly so, has a downgrade to the west, and yielded at the west portal, as Mr. Walker says, one million gallons per day. This yield is equivalent to 1.54 sec.-ft. for the 2.6 mi., or 0.6 sec.-ft. per mi. of tunnel, or 1.8 gal. per min. for each 15 ft. of tunnel. From a tunneling standpoint such an amount is almost negligible. If this may be taken as a criterion, then it augurs well for the lower tunnel. The porosity of the granites so near the surface always yields more water than the tightly sealed, impermeable conditions usually prevailing at great depth, such as will be occupied by most of the projected tunnel.

Dubrée, Delesse and other authorities have shown that the interstitial water content, sometimes called quarry damp, of granite is 0.37% by weight. If the daily rate of progress in driving the proposed double-track tunnel be 15 ft., then a simple computation shows that the yield of interstitial water, if it could be resolved into a flowing stream, would be 117 cu.ft. for one day's driving and would be greater or less according to progress.

The water yield in the present tunnel, according to Mr. Walker, was one million gallons per day for 2.6 mi., which is equivalent to a daily yield of 147 cu.ft. of percolation water for every 15 ft. of tunnel. In this instance we thus have as a suggestive index of yield a coefficient of $\frac{147}{117} = 1.26$ times interstitial-water content.

According to the above, we may calculate that the flow at the east portal will be 3,390,000 gal. per day, and at the west portal 6,780,000 gal. per day, the respective equivalents being 5.25 sec.-ft. and 10.5 sec.-ft. These results assume that the typical homogeneous granite will prevail throughout the length of the proposed tunnel. No doubt some diamond-drill explorations will be undertaken prior to the final adoption of the plan, and they will probably fairly establish the nature of the lithology.

But it may be objected that inasmuch as the present tunnel does not pass under or near any streams or lakes and that inasmuch as the one proposed is to pass under a number of streams and possibly some lakes that the yield of the latter cannot in any wise be predicated upon the yield of the former.

Suppose that the yield per unit of length were 10 times greater in the proposed tunnel than in the present tunnel; then we would have 60 sec.-ft. discharging at the east portal and 120 sec.-ft. at the west portal. On the eastbound gradient of 0.1% as proposed by General Chittenden, this would give a velocity of about 4.5 ft. per sec. in a lined drain channel having a hydraulic radius of, say, about 1.25, which means a wet section of 13.5 sq.ft., the equivalent of about 3-ft. depth of water in the flattened invert of a side tunnel 6 ft. wide. On the westbound gradient of 0.2%, with hydraulic radius of 1.46, the velocity would be about 7 ft. per sec., thus giving nearly the same depth of water in the invert.

It thus becomes clear that even on the assumption of a flow 10 times greater than the yield per unit in the present tunnel this amount of water would still impose neither a handicap upon the progress of the work nor extra cost in construction.

The St. Gothard tunnel, 9.5 mi. long, passes under the Kestelhorn, the peak of which is about 6000 ft. above the tunnel, also under the St. Anne glacier, and under the River Reuss six times, without encountering a water-bearing fault or any fault.

It is a well-known geologic fact that homogeneous and insoluble rocks like granite, although characterized by divisional planes caused by the dynamics of shear and fracture, seldom have open fissures at depth. The system of joints which have contributed so largely to the type of scenery and physiography of this wonderful region are not faults. The permeable depth to which they originally descended has long since been reached by the subaërial agencies of erosion, so that the waters of the several streams under which the tunnel is to run are hermetically impounded hundreds of feet above. Gashes near the surface may exist, but profound fault planes filled with breccia or attrition matter for the carriage of water are now undoubtedly nonexistent. In places through the Cascade fields there are north-south dikes, but these are tightly sealed and offer no possible percolation channels. Almost the entire route of the proposed tunnel is traversed by a massive granite of remarkable homogeneity. Such a formation is not a water-bearing one.

The most notable feature of the drainage system of the region is the remarkably flat gradients (almost railroad gradients) of all the larger streams and the unusual distances which those low gradients extend up toward the head of the streams. The result is that the extreme upper end of the gradients running up to the main divide and the portion thereof which the proposed tunnel undercuts are very steep and precipitous. Clearly, this is a condition that will give an immediate 100% runoff of surface waters. This, then, is the physiography that has resulted in defining both sides of the range into colossal escarpments.

There are many cirques, or bowl-like recesses, of glacial origin, surrounded by precipitous walls often several hundred feet high, but in every instance one side of their rims has been eroded completely away, and the break always heads into the stream-cut channel as a part of the drainage system. Consequently, notwithstanding the great amount of precipitation, the presence of many surface streams over the tunnel and the rugged complexity of knife-edged ridges, tapering monoliths and peaks, terrenes, cirques, miniature valleys and sweeping slopes, the whole drainage will shed water like a shingled roof.

These bold structural and unique features must translate themselves into favorable significance for the tunnel project; and if not conclusive, must certainly go far toward sustaining the contention that the tunnel will not encounter excessive amounts of water. J. C. RALSTON.

Spokane, Wash., Jan. 3, 1917.

Better Salamanders Suggested

Sir—The time of the year is here when the great majority of concrete-structure failures occur, and the salamander appears in an attempt to promote proper setting. My own experience, and I find if the experience of others, is that the hot dry air from the salamander fire dries out the concrete directly above the stove too quickly, so that often the concrete there can be picked to pieces with the fingers. I have been wondering if a small change in the salamanders would not prevent this action and so add to the safety of winter work.

I would add three or four short legs to the top of the salamander and have these support the rim of an inverted cone of the same diameter as the stove. This addition would serve two purposes: First, it would deflect the hot-air blast so that the current would not rise so directly to the ceiling. Secondly, the cone could be kept filled with water, the evaporation of which would moisten the rising air and further protect the concrete from rapid drying out.

The extra cost of the cone would be small.

Ohio State University, Dec. 18, 1916. W. NEILSON.

Four Spans of Union Pacific's Omaha Bridge Rolled to Place

Replacing the old double-track Missouri River bridge of the Union Pacific R.R. at Omaha, Neb., by a new bridge on Saturday, Dec. 23, 1916, was one of the heaviest bridge-rolling jobs ever accomplished. The four 250-ft. river spans were rolled in simultaneously, a total weight of 3580 tons. The four old spans, weighing 1950 tons, were rolled out onto trestle extensions of the piers before the new spans were moved.

The five main piers of the old bridge, resting on rock about 75 ft. below water, were used without change for the new structure.

The new spans are 246 ft. 3 in. long c. to c. of end pins, 47 ft. deep at the center, and have trusses spaced 31½ ft. apart c. to c. In place of the Whipple truss system of the old spans, they have 10-panel curved-chord Pratt trusses. Both old and new bridges are pin-connected. The total length of the bridge is 1749 ft.

The design of trusses as well as floor is normal; the comparison of weights (3580 tons against 1950 tons, for the four main spans) indicates the difference in strength. A special feature is a set of pier girders, three 27-in. plate girders under each end of each span, longitudinal of the pier, to reinforce the pier masonry.

The new spans were erected on falsework, just downstream of the old bridge. Timber-trestle pier extensions founded on piles were built downstream and upstream of the piers (the upstream extensions to receive the old bridge when rolled out); when the spans were completed they were swung on these trestles and the intermediate falsework removed. One of two channel openings had to be kept clear of falsework during the erection but this requirement did not complicate the work.

The pier girders, carrying the fixed and expansion shoes, were erected with the new spans, and served as track girders bearing on the traveling roller nest.

The old spans were jacked up 2 ft. to raise the track after the new structure had been erected, because the new floor is deeper than the old by this amount. At the same time the roller tracks were inserted. The jacking was done on one pier at a time, the grade running out easily in a span length.

The traffic across the bridge is extraordinarily heavy, averaging 300 trains per day for a year. For this reason moving the bridge between trains was not contemplated. Arrangements were made to detour trains over another bridge.

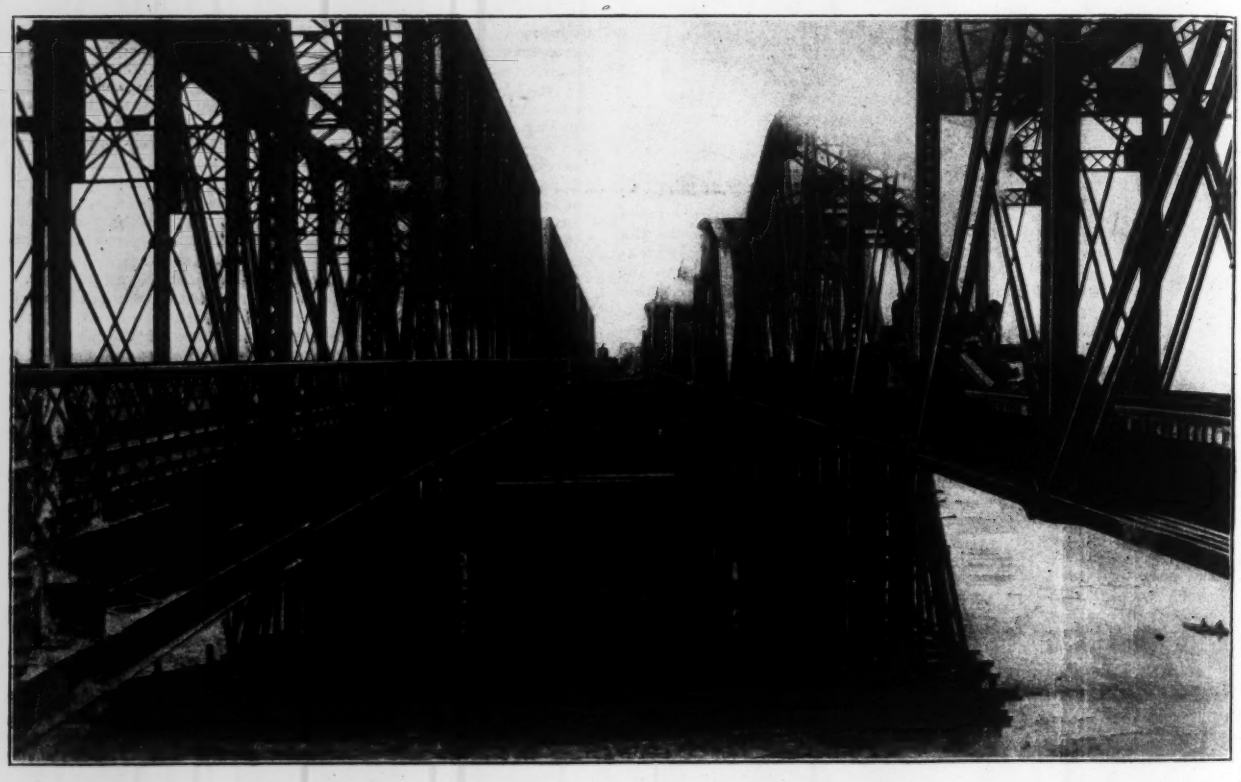


FIG. 1. UNION PACIFIC BRIDGE OVER MISSOURI RIVER BEING REPLACED BY ROLLING
Old Whipple bridge at left, new bridge at right; view looking east from Omaha end

Each span was fitted with a 9-part hauling tackle at each end. The lines were handled by hoisting engines standing on the new bridge near the piers. Travel indicators were provided to keep the engines working in unison and hold the moving spans in true alignment.

The bridge tracks were broken at 11:10 a.m., Dec. 23, and by 11:20 all was ready for the moving. The old bridge moved over without trouble, up to within 6 ft. of final position, when the breaking of a hitch caused 30 min. delay. The movement of the old spans was completed at 12 noon.

Zero temperature prevailed at the time. The cold hampered operations somewhat, but by 3:30 p.m. the

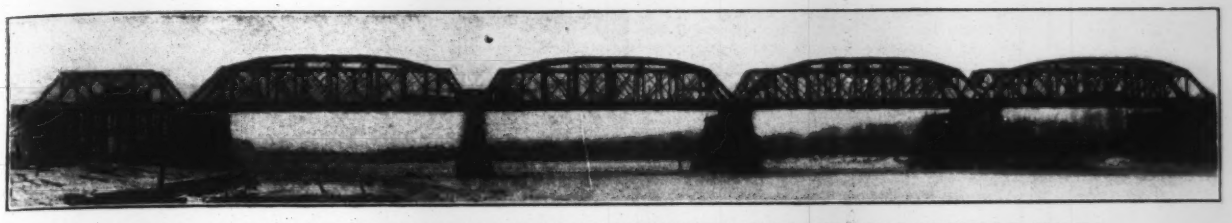


FIG. 2. LOOKING UPSTREAM AT UNION PACIFIC BRIDGE OVER MISSOURI RIVER AT OMAHA
New bridge in foreground, on trestle supports; old bridge still on masonry

new spans were in place on the piers. The spans remained in excellent alignment throughout the moving.

The only remaining piece of work to restore track connections was jacking up the outer ends of the end spans and removing the roller nests. Freezing of jacks delayed this work. The first train crossed the new bridge about 9:40 in the evening.

The entire erection work followed schedule so closely that the actual moving date did not differ more than a week or two from that anticipated at the start of operations. The hauling power provided for the moving also proved ample, the engines being at no time overworked.

It is interesting to record that this Missouri River crossing dates back a full half-century. A ferry for transcontinental railway service was established here just after the Civil War, and a few years later the Union Pacific Ry. built a single-track bridge (begun 1869, opened 1872). This did service for 15 years. It was replaced in 1887-1889 by a double-track bridge of George S. Morison's design, which has held its place till the end of 1916—nearly 30 years.

Morison's bridge was designed for a live-load about equivalent to Cooper's E35. The 1916 bridge is designed for a Union Pacific loading not far from E65 (65,000 lb. on drivers, 5500 lb. per ft. moving load), and full impact is figured on both tracks. However, the old bridge had excess strength insofar as it was designed for two vehicle roadways in addition to the tracks—3000 lb. per ft. on each track, and 1000 lb. per ft. on each roadway, a total of 8000 for the bridge. The new bridge also has an excess over present-day requirements, the normal design loading of the Union Pacific being about E55; for this important bridge a considerable excess was thought warranted.

The new bridge was designed under the direction of E. E. Adams, Consulting Engineer, Union Pacific System, New York City; R. L. Huntley, Chief Engineer, and W. L. Brayton, Bridge Engineer, Omaha. It was built and erected by the American Bridge Co.; K. L. Strickland was in local charge of the work for the bridge company.

High Dam Part of $9,000,000 Kings River Irrigation Project

A 1,000,000-acre irrigation district project, including a high dam, a hydro-electric plant and 605 electric pumping stations, has been indorsed by Louis C. Hill, consulting engineer of the United States Reclamation Service, in a recent report to the Director of the Service. The district lies in Tulare, Kings and Fresno Counties, near Fresno, Calif. A number of canal companies now supply water from Kings River to 600,000 acres of this land, but at present there is no storage on the river.

Kings River has a drainage area of 1740 sq.mi. above the eastern margin of the San Joaquin Valley and extends back to the top of the Sierra Nevada Mountains, which range from 5000 to 14,000 ft. in elevation. Its winter discharge is flashy in character, but the stream has a more constant summer flow than the rivers farther south. The minimum summer flow is seldom less than 200 sec.-ft. and generally averages 300 sec.-ft. Winter flood flows for short periods of time have run as large as 50,000 sec.-ft.

The seasonal flow curve of Kings River follows closely the curve of irrigation demand, so that a reservoir having a relatively small storage capacity will act effectively as a regulator for irrigation purposes. The project calls for the building of the Pine Flats Reservoir with a capacity of 600,000 acre-ft. and a water depth of 300 ft. at the dam site.

An arched masonry dam of gravity section, with a 1450-ft. radius and a crest length of about 1400 ft. at a height of 305 ft. above the stream bed, is proposed. It is estimated that an annual supply of 1,700,000 acre-ft. can be obtained from the surface flow of Kings River by regulation through this reservoir.

The water plane is quite close to the surface in a large area of the lower portion of the proposed district, in some cases being within 4 ft. It is a part of the proposed plan to develop an additional supply of 300,000 acre-ft. by pumping from this underground reservoir. The plan calls for 605 electrically equipped pumping plants of 2 sec.-ft. capacity each, having an average lift of 35 ft. The electric power for these plants would be supplied from a power plant to be built in connection with the Pine Flats dam.

The total available water-supply is estimated to be 2,000,000 acre-ft. per annum, which is sufficient to irrigate approximately 1,000,000 acres of land. The irrigation season extends over a period of seven months. The duty of water for the crops raised in this vicinity varies from 2 to 2¼ ft., measured at the point of diversion. The average rainfall is 10 in.

The estimated cost of the entire project is $9,530,000, including the power plant at the dam, transmission lines and pumping plants, or $9.53 per acre benefited.

The general scheme is to buy out the various irrigation companies and organize one or perhaps a number of irrigation districts. Some of the men connected with the companies are reported as having informally approved the project and an educational campaign is under way to win the support of all concerned.

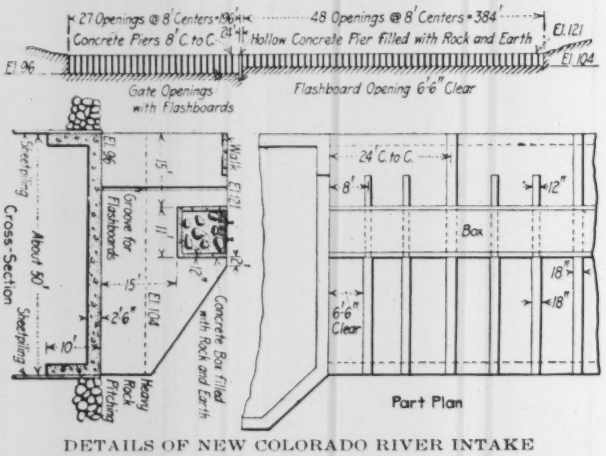
City Engineers' Offices in Office Buildings are a feature of municipal arrangements in some cities, and in several of these cases all the municipal offices are located in the building, in preference to establishing a city hall. The reason usually is one of economy, it being cheaper to rent offices than to build and maintain a municipal structure.

News of the Engineering World

New Colorado River Intake Gate for Imperial Irrigation Canal

A large new reinforced-concrete heading for the main, or Imperial, canal of the Imperial Irrigation District, California, is to be built on the California side of the Colorado River, about a mile above the present intake, called Hanlon's Heading. The new intake may be named the Rockwood Gate, after C. R. Rockwood, who was recently succeeded as chief engineer by C. K. Clarke. The new intake was designed and the specifications for it prepared by Edward R. Bowen, structural engineer in the offices of J. B. Lippincott, Los Angeles, Calif.

The intake is about 600 ft. long and consists of a reinforced-concrete floor some 50 ft. wide, carrying piers that serve the double function of supporting the flash-



DETAILS OF NEW COLORADO RIVER INTAKE
Some of the dimensions are approximate

boards and carrying an electric railway to operate the flashboards electrically from cars (see illustration). The structure will be built 50 ft. back from the present river bank, which will be shaped to the structure and protected by derrick-placed stone pitching.

The upstream end of the heading is to be built into a hill of indurated sand, and the downstream half will rest on the river silt common to the locality. Provision has been made for arc lights on top of the structure and spray lights in each bay. A new canal is being dredged from the present Hanlon Gate to the proposed new intake. The water levels in this canal may be controlled by the operation of the Hanlon Gate.

The theory of the operation of the new intake is that during high water it will skim the top 2 or 3 ft. from the surface, and because of its great length and the control of the water levels on the land side by the Hanlon Gate the entrance velocity will be small. This will result in much less trouble with drift and silt.

Rough preliminary estimates indicated a cost of about $200,000. Bids have since been received, and it is expected that the contract will soon be awarded.

New England Water-Works Association Holds Annual Meeting

There was a large attendance at the annual meeting of the New England Water-Works Association, held in Boston on Jan. 10. A report on the canvass of ballots showed the election of Caleb Mills Saville, Chief Engineer of the Water Board of Hartford, Conn., as president of the association for the ensuing year. Willard Kent, Narragansett Pier, R. I., was reëlected secretary. The total membership of the association is 1043, a net gain of 82 for the year.

In his retiring presidential address William F. Sullivan, Nashua, N. H., was very outspoken in his opinion of the correspondence campaign for the consolidation of the New England Water-Works Association and the American Water-Works Association as carried on by an unnamed journal. Mr. Sullivan advised that the agitation be ignored, and accused the journal of conducting it as a subscription-getting project. He urged that there are ample fields for both organizations and that one might as well talk of consolidating all the colleges, all the magazines in a given class or all the political parties.

A paper on "The First Slow Sand Filter in the State of Maine" was read by Henry Richards, trustee of the Gardner Water District. Mr. Gardner took up the human, social and political aspects of getting a public improvement in a conservative locality as being of more importance than the technical side of such a small installation as the one at Gardner. He attributed the fact that Gardner was the first municipality to establish a filter plant to the fact that it has the commission form of government. The filter plant has a capacity of about 1,000,000 gal. a day, and the clear-water basin holds 700,000 gal. Although the quantities of excavation, both in earth and rock, considerably exceeded the estimate, the cost was exactly the same as the engineer's estimate, or about $74,000. The population of Gardner is 8000 and is rather stationary. The water-supply was originally one of the best in Maine, but increasing population on the drainage area made filtration necessary or at least desirable.

In the course of a discussion on public-service commissions Leonard Metcalf, past president of the association, pointed out that regulation is useful in that it brings together the parties interested, making for good feeling and tending to settle issues at small cost compared with settlement by litigation.

Unique Telephone-Merger Ordinance Adopted in Austin, Texas

The voters of Austin, Tex., on Jan. 4, accepted, 6 to 1, a franchise ordinance for the merger of the local Bell and independent telephone systems and for an increase of rates for the new service. The Bell exchange (Southwestern Telegraph and Telephone Co.) had 5400 subscribers and the other exchange (United Telephone Co.)

had 800 within the city and 1500 outside. The Bell company had better long distance facilities, but the independent concern had connection with rural lines throughout the county.

The ordinance provisions are so unusual that the more important stipulations are summarized below. The full ordinance was published in an election proclamation in the Austin *American* Dec. 19, 1916.

The Southwestern company is to expend at once $300,000 in system improvements, including $75,000 for a modern exchange building with special comforts for women employees. All the independent company's aërial construction not needed is to be quickly removed. The overhead and underground equipment of both companies at the time of merger is to be shown on plans filed with the Superintendent of Public Improvements, and plans for all new construction are to be similarly filed.

Such equipment is to be under the reasonable control of the city and must not interfere with ordinary use of streets or obstruct any other utility. The company is to use alleys instead of streets wherever possible. One duct in all underground lines and part of the top crossarm of all poles are to be left and donated for the fire-alarm and police wires, but no electric power or high-voltage wires which will affect telephone service are to be placed thereon.

A definite program for removing the overhead construction is fixed. A pole line may not be rebuilt along any permanently paved street without the approval of the City Council, and where it is practical to construct a parallel line along some street or alley at reasonable expense.

Wages of local operators are to be raised not less than 10%.

The new rates are to be: $5 per month for business telephones, $1 per month for business extensions, $2.50 per month for additional one-way-service telephones, $2 per month for residence stations and 50c. per month for each residence extension. These rates are effective when the $300,000 improvments have been completed and for service through the new exchange. Rates may be raised on petition after five years provided this schedule does not yield a reasonable net profit on its capital investment in and about the city. The Council may lower rates at any time if profits are excessive. A complete inventory of the company's property is to be maintained and held open for the city's inspection and audit. In case of controversy over a rate petition a board of arbitration is to fix the value of the investment. No appeal or resort to the courts may be had by either party for modifying the award of arbitrators.

The company is required to protect the city against all damages growing out of this franchise or the construction and maintenance of the telephone system.

The life of the franchise is 25 years. At the end of 10 years, and each five-year period thereafter, the city may purchase the telephone system at a price fixed by a board of appraisers. The company pays $1250 per annum and 1½% of the gross receipts in addition to the usual lawful taxes on real property.

New York Garbage-Reduction Works Controversy May Be Over

The protracted and sometimes hot controversy over the new contract for the disposal of the garbage of New York City for the five years beginning Jan. 1, 1917, seems to have come back to roost with Governor Whitman for awhile, but under conditions so favorable to the city as to give rise to the hope that the controversy is over. Geo. C. Whipple, professor of sanitary engineering at Harvard University, and member of Hazen, Whipple & Fuller, New York City, submitted a report on Dec. 9, 1916, advising that in his opinion the proposed works would not be a detriment to health, but containing some other statements that may be noted in the following conclusions from Professor Whipple's report:

1. The transportation of garbage in scows from the boroughs of Manhattan, Bronx and Brooklyn, to Fresh Kills, Staten Island, and its disposal there by the Cobwell process of reduction, as proposed under the contract, will not, in any appreciable or material way, affect the security of life or endanger the health of the people of Staten Island.

2. The garbage-disposal works will, by reason of odors emitted at certain times, be a nuisance (within the meaning of Sect. 6 of the Public Health Law and Sect. 1530 of the Penal Law) within the low-lying part of Staten Island which may be described as the Fresh Kill Marshes, including the village of Linoleumville, the small settlement known as Fresh Kills and certain highways; but this nuisance will not extend generally over Staten Island.

3. The transportation of garbage in scows, as provided for by the contract, will, under certain conditions, be an offense to the residents of Staten Island along the Kill von Kull and to persons on passing boats and vessels on the Kill von Kull and Arthur Kill. Garbage and waste products will also be scattered so as to litter the banks of the Fresh Kills.

4. The Cobwell reduction process is the best method now known and available for the disposal of the garbage of the city of New York.

5. From a sanitary standpoint there are other sites in New York city more suitable and satisfactory for the location of a garbage-reduction plant employing the Cobwell process than the Fresh Kills site at Staten Island—namely, either Riker's Island or Barren Island.

Professor Whipple came into this case as follows: After it was decided to award the contract for a plant on the Staten Island site, Staten Islanders asked Governor Whitman to intervene. After a hearing he referred the matter (July 15) to the State Commissioner of Health, Dr. H. M. Biggs, for investigation under Sec. 6 of the Public Health Law. It was subsequently taken up by Dr. Linsly R. Williams, deputy health commissioner, Theo. Horton, chief engineer of the State Department of Health, and Wilber W. Chambers, deputy attorney-general, Professor Whipple acting as special consultant, and all three of the men named sitting with Dr. Williams at hearings on Staten Island, extending over 12 days. It was agreed that Professor Whipple should write a report after reviewing the typewritten testimony, filling 1694 pages. This he did after consultation with the other three.

Dr. Williams transmitted Professor Whipple's report and all the testimony to Commissioner Biggs, accompanied by a brief report, concluding with these findings:

1. The transportation of garbage to the site of the proposed plant and the operation of the plant at Lake Island will not affect in any material way the life or health of the inhabitants of Staten Island.

2. The transportation of garbage in scows to the proposed plant as provided for by the contract at times and under certain conditions of atmosphere and transportation will be offensive to the residents of Staten Island living along the Kill von Kull and the Arthur Kill and will thereby constitute a nuisance.

3. The operation of the proposed plant will disseminate objectionable odors at times and under certain atmospheric and operative conditions in the neighborhood of the proposed plant, including the village of Linoleumville, the settlement known as Fresh Kills and other property located in that vicinity.

All the documents mentioned were transmitted to Governor Whitman, on Dec. 27, by Commissioner Biggs, with the statement that he had carefully considered all the evidence and reports and entirely concurred in the conclusions reached. So far as has been reported, Governor Whitman has taken no action in the case.

Garbage and Refuse Disposal as practiced in various cities of the United States will be investigated by the Board of Health of Cincinnati, Ohio, with funds provided by the City Council on Jan. 9.

Sewage-Treatment Works for Dallas, Tex., were put in operation on Jan. 4, 1917. The plant consists of primary and secondary Imhoff tanks with sprinkling filters between. James H. Fuertes, consulting engineer, New York City, designed the system. Hal Moseley is city engineer.

Federal Water Power Legislation was taken up in the Senate on Jan. 11, but the opposition during the following three days was successful in preventing a vote by prolonged discussion. The prospect that legislation can be secured during the few remaining weeks of the present session appears to be diminishing.

Joint Water-Works and Sewerage Systems for six Canadian municipalities near Detroit, Mich., are proposed. The project embraces Windsor, Walkerville, Ford City, Sandwich, Ojibway and the Township of Sandwich West, and is in charge of the Essex Borders Utilities Commission, created a year ago by the Ontario provincial legislature. The chairman of the commission is Gordon McGregor, Ford City, Ont., managing director of the Ford City Motor Co. There is a board of engineers, consisting of the city engineers of the six municipalities, and having as chairman Edward Brian, city engineer of Windsor, Ont. Morris Knowles, Pittsburgh, Penn., is consulting engineer to the board of engineers.

Another Municipally Owned Garbage-Reduction Works—On Jan. 1, 1917, Rochester, N. Y., took possession of the garbage-reduction works and the collection equipment of the Genesee Reduction Co., putting itself in the class with Chicago (Ill.), Cleveland, Columbus and Akron (Ohio), Schenectady (N. Y.) and perhaps one or two other cities. The property acquired by Rochester included 16 digester tanks, presses and accessories, with a daily capacity of 175 tons, and 35 teams with steel wagons. The city exercised an option to buy at the expiration of the contract between it and the company. The price was fixed at $127,414 by Irwin S. Osborn, of Cleveland, for the city; George D. Beaston, of Philadelphia, for the company, and W. J. Springborn, New Bedford, Mass., chosen by the other two arbitrators. No plans for remodeling or extending the plant have yet been made, we are informed by E. A. Fisher, consulting engineer to the City of Rochester, but such plans may possibly be made in the future.

PERSONALS

F. H. Boyd, County Surveyor of Rogers County, Oklahoma, has been appointed County Engineer.

Charles Lawrence, Engineer of the paving department of Warren, Ohio, has been appointed City Engineer.

Joseph McGuire has been made County Engineer of Johnson County, Missouri, with office at Warrensburg.

J. T. M. Hamilton has been appointed Chief Engineer of the Meridian & Bigbee R.R., Meridian, Miss.

W. W. Lane, of Tucson, Ariz., has been appointed County Engineer of Pinal County, with offices at Florence, Ariz.

Joseph R. Greenwood has become associated with Charles H. Higgins, Engineers and Architects, 165 Broadway, New York City.

J. G. Blunt, Superintendent of the general drafting room of the American Locomotive Co., Schenectady, N. Y., has been promoted to be Mechanical Engineer of the company.

E. K. Hall has resigned as Vice-President of the New England Telephone and Telegraph Co., Boston, Mass., to become Vice-President of the Electric Bond and Share Co., New York City.

A. L. Mathews has been elected a Vice-President of the J. G. White Management Corporation to take charge of a new department, which has been organized to manage sugar properties.

Harry W. Vetter has been appointed County Engineer of Warren County, New Jersey, succeeding Fred W. Salmon. He is a graduate of Lafayette College, class of 1911, and has been Assistant County Engineer.

James L. Kilpatrick, Assoc. Am. Inst. E. E., of the plant department of the Bell Telephone Co. of Pennsylvania, Philadelphia, Penn., has been appointed Engineer to succeed Nathan Hayward, resigned, as noted elsewhere.

H. C. Hearne, recently of the firm of the Samuel M. Green Co, Engineers and Architects, Springfield, Mass., has opened an office for private practice as Architect and Engineer, in the Third National Bank Bldg., Springfield.

R. M. Robinson, Jun. Am. Soc. C. E., has left his position with the Clinchfield (Ohio) Products Corporation to go with the Gifford-Wood Co., Hudson, N. Y. He was formerly with the Tennessee Copper Co., Copperhill, Tenn.

Spencer Cosby, M. Am. Soc. C. E., Lieutenant-Colonel, Corps of Engineers, U. S. A., Military Attaché of the American Embassy in Paris, has been ordered home. He will be succeeded by Capt. Carl Boyd, of the Third Cavalry.

Joseph E. Kuhn, Colonel, Corps of Engineers, U. S. A., has been nominated by the President to be Brigadier-General of the line, effective Jan. 2. Until recently General Kuhn was Military Observer with the armies of the Central Powers, at Berlin.

A. A. Miller has been appointed Engineer of Maintenance-of-Way of the Missouri Pacific Ry., with headquarters at Little Rock, Ark., succeeding R. C. White, resigned, as noted in these columns of last week. He was formerly General Roadmaster at Poplar Bluff, Mo.

L. T. Putman, Chief Engineer of the Christopher Coal Mining Co., Benton, Ill., and **C. B. Mautz,** former Assistant Engineer of the Chicago & Eastern Illinois R.R., at Danville, Ill., have formed a partnership under the firm name of Putman & Mautz, with offices at Benton.

Farley Gannett, M. Am. Soc. C. E., announces that he will hereafter conduct his practice together with his two associates, **Theodore E. Seelye** and **Samuel W. Fleming, Jr.,** under the firm name of Gannett, Seelye & Fleming, Consulting Engineers, 204 Locust St., Harrisburg, Penn.

Nathan Hayward, M. Am. Inst. E. E., has resigned as Engineer of the Bell Telephone Co. of Pennsylvania, Philadelphia, Penn., to become President of the American Dredging Co., Wilmington, Del. He is a graduate of the Massachusetts Institute of Technology and was formerly a member of its faculty.

Charles R. Rockwood, M. Am. Soc. C. E., who recently retired as Chief Engineer of the Imperial Valley irrigation district, is to be honored by the City of Calexico, Calif., by naming the city plaza Rockwood Plaza. In its infancy Mr. Rockwood presented the city with a block of land to be devoted to a public park.

George D. Marshall, Highway Engineer, United States Office of Public Roads and Rural Engineering, recently in charge of work at Austin, Tex., has been transferred to the Southern division of the Washington-Atlanta highway, Atlanta, Ga. This is one of the principal highways on which the Government is studying maintenance methods.

W. B. Davey, recently an Assistant Engineer with the New Orleans Sewerage and Water Board, has been appointed Assistant Engineer of the Orleans Levee Board, succeeding Edward R. Barnes, resigned. Mr. Davey was with the State Board of Engineers for three years prior to 1906, when he went to the New Orleans Sewerage and Water Board.

Harry F. Harris, Assoc. M. Am. Soc. C. E., recently Engineer of Streets, Department of Streets and Public Improvements, Trenton, N. J., has been appointed County Engineer of Mercer County, New Jersey. He has been connected with the city engineering staff of Trenton for 13 years, prior to which he was with the American Bridge Co. as a structural draftsman.

Crosby J. McGiffert, whose appointment as Acting Town Engineer of Montclair, N. J., was noted in these columns of last week, has refused to accept the appointment on the ground that no salary or term of office was stipulated. Mortimer E. Harrison, former Mayor and now a member of the city commission, will take charge of the engineering bureau of the town on Feb. 1.

Shirley Baker, M. Am. Soc. C. E., formerly Construction Engineer, **Edward Emery Carpenter,** M. Am. Soc. C. E., formerly Chief Civil Engineer, and **William Waters,** formerly Superintendent of Building Construction, of the Panama-Pacific International Exposition, announce that they have joined forces under the firm name of Baker, Carpenter & Waters, Consulting Engineers, 58 Sutter St., San Francisco, Calif.

Lee H. Powell has resigned as Division Engineer of the J. B. McCrary Co., Atlanta, Ga., to become Chief Engineer of Road District No. 1, Cherokee County, Texas, with headquarters at Jacksonville, Tex. It is proposed to construct 100 mi. of highways of local iron-ore gravel by a $200,000 bond issue; of this $50,000 will be reserved as a maintenance fund to be expended during the next five years.

John W. Reid has been appointed Engineer-in-Charge of the newly created Bureau of Grade Separation, Department of Public Works, Detroit, Mich. This bureau is a part of the organization of the office of the city engineer. Mr. Reid has served in the office of the city engineer during the past 17 years in various capacities, and his duties included the preparation of grade separation plans and estimates of damages. He was admitted to the practice of law in the State of Michigan in 1897.

R. M. Feustel, Assoc. M. Am. Soc. C. E., of Sloan, Huddle, Feustel & Freeman, Consulting Engineers, Madison, Wis., has been elected President of the Fort Wayne & Northern Indiana Traction Co., which includes the interurban lines from Fort Wayne to Lafayette and Bluffton and the local street railways of Fort Wayne, Logansport and Lafayette, Ind. Mr. Feustel was formerly Chief Engineer of the Wisconsin Railroad Commission. Recently he has been Consulting Engineer of the Bay State Ry., Boston, Mass.

David F. Crawford, M. Am. Soc. M. E., Superintendent of Motive Power of the Pennsylvania R.R. Lines West of Pitts-

burgh, has been promoted to be General Manager, with offices at Pittsburgh, Penn., succeeding Benjamin McKeen, promoted, as noted elsewhere. Mr. Crawford began his railway experience in 1880 as a clerk in the freight department of the Pittsburgh, Fort Wayne & Chicago R.R. Afterward he served four years as an apprentice in the Altoona shops of the Pennsylvania R.R. Since then he has advanced rapidly in the mechanical department.

George W. Fuller and **James R. McClintock,** M.'s Am. Soc. C. E., of the firm of George W. Fuller, Consulting Engineers, 170 Broadway, New York City, announce that they have admitted to partnership Jesse K. Giesey, Assoc. M. Am. Soc. C. E., and that the firm name hereafter will be known as Fuller & McClintock. Mr. Giesey graduated at Rensselaer Polytechnic Institute in 1904. He was a member of the staff of Hering & Fuller from 1904 to 1911; Assistant Engineer with Hering & Gregory from 1911 to 1914; and for the past 2½ years has been in charge of the construction of the outfall sewer, pumping station and sewage treatment works at York, Penn.

A. W. K. Billings, M. Am. Soc. C. E., has returned from Barcelona, Spain, where he has been for the past five years as Manager of Construction, Managing Director and Vice-President of the Ebro Irrigation and Power Co., Ltd., and allied interests, in responsible charge of extensive hydro-electric construction and other work. Over 110,000 hp. has already been developed, one interesting feature being the construction of the largest dam in Europe under very unusual conditions. Previous to his work in Spain and elsewhere for the Pearson interests, Mr. Billings spent two years in Pittsburgh and ten years in Cuba, principally on electric-railway and power-plant construction, and two years in New York as Engineering Manager of J. G. White & Co., Inc. He has opened an office as Consulting Engineer at 115 Broadway, New York City, and will devote considerable attention to work in Europe and in Latin America.

Benjamin McKeen, M. Am. Soc. C. E., General Manager of the Pennsylvania R.R. Lines West of Pittsburgh, has been promoted to be Fifth Vice-President, with offices at Pittsburgh, Penn. He was born in 1864. He attended Worcester Polytechnic Institute in 1881 and 1882 and then entered Rose Polytechnic Institute where he graduated in 1885 in mechanical engineering. After about a year as a mechanical draftsman with the Terre Haute & Indianapolis (Vandalia) R.R. he joined the field engineering staff of the railway as a rodman. From 1886 and 1887 he was Resident Engineer on construction of the Terre Haute & Logansport R.R. In 1889 he was made Chief Engineer of Construction of the Indiana & Lake Michigan R.R. He joined the operating staff in 1894 as Superintendent of the Peoria division of the Terre Haute & Indianapolis, and since then he was promoted steadily to the office of General Manager of the Pennsylvania Lines West on Jan. 1, 1913.

OBITUARY

Richard M. Pancoast, a retired civil engineer of Camden, N. J., died Jan. 5, aged 70 years.

William Miner, who made some of the first land surveys in the Black Hills country of South Dakota, died Jan. 4 at his home in St. Cloud, Minn., aged 71 years. He went to what is now Yankton, S. D., in 1860 and made the first survey there. Later he conducted a freighting business through the Black Hills.

Thomas Malcolm, a prominent railway contractor of eastern Canada, died at Campbellton, N. B., Jan. 10, aged 63 years. With the late John J. Macdonald he was contractor on the section of the Canadian Pacific Ry. around Lake Superior. Later with Messrs. Boswell and Ross he was contractor for the Temiscouata Ry. and other lines.

Charles C. Ramsey, President of the Crucible Steel Co. of America, Pittsburgh, Penn., one of the best known steel manufacturers in this country, died Jan. 11 from pneumonia. He was in his 55th year. He was born in Allegheny, Penn., and began his business career as a stenographer in the offices of the Pennsylvania Co. He was a member of the Engineers' Club of New York City.

James K. Ryan, senior member of the firm of Ryan & Keon, bridge and railroad contractors, Boston, Mass., died in St. Louis, Mo., Jan. 5. He was born in Brooklyn, N. Y., and some of his earliest work was the construction of the Brooklyn & Coney Island R.R. (now a part of the Brooklyn Rapid Transit Co.). Afterward he executed many contracts on the New York, New Haven & Hartford R.R. At the time of his death his firm had underway the construction of the Central bridge, Lawrence, Mass. He is survived by two sons, J. L. and C. J. Ryan, who are associated with their father's business.

Henry Gordon Stott, Past-President of the American Institute of Electrical Engineers, Superintendent of Motive Power of the Interborough Rapid Transit Co. and the New York Railways Co., died Jan. 15, at his home in New Rochelle, N. Y. He was born in Scotland in 1866 and received his technical education at what is now the Glasgow and West of Scotland Technical College. His engineering experience began in his native country as an employee of the local electric-light company at Glasgow. Shortly afterward he received an appointment with the Anglo-American Telegraph Co. as Assistant Electrician on the steamship "Minia," engaged in repairs to submarine cables. Leaving this position he became Assistant Engineer of the Brush Electric Engineering Co., of London. In September, 1891, he came to this country to take charge of putting in the underground cables and conduits of the Buffalo Light and Power Co., Buffalo, N. Y. On completion of this work he became Engineer of the company and built the power plant on Wilkeson St. On Mar. 1, 1901, Mr. Stott was appointed Superintendent of Motive Power of the Manhattan Railway Co., New York City, and ever since then has had charge of the motive power departments of the New York City (Manhattan) elevated and subway lines, and after the consolidation of all the transit lines he was made Superintendent of Motive Power of the surface lines, the New York Railways Co., also. He was the author of many papers and articles on power engineering. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers and of the Engineers' Club, New York. A more complete biography and a portrait were published in "Engineering News" of Jan. 23, 1908, at the time of his election to the presidency of the American Institute of Electrical Engineers.

ENGINEERING SOCIETIES

WESTERN BRICK MANUFACTURERS' ASSOCIATION.
Jan. 20. Meeting in Kansas City, Mo. Secy., G. W. Thurston, 416 Dwight Building, Kansas City.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 23-25. Annual meeting in Montreal, Can. Secy., C. H. McLeod, 176 Mansfield St., Montreal.

ILLINOIS SOCIETY OF ENGINEERS.
Jan. 25-26. At Chicago. Secy., E. E. R. Tratman, Wheaton, Ill.

NORTH DAKOTA SOCIETY OF ENGINEERS.
Jan. 30-31. Annual meeting in Bismarck. Secy., E. F. Chandler, University, N. D.

OHIO ENGINEERING SOCIETY.
Jan. 31-Feb. 2. Annual meeting. Ohio State University, Columbus, Ohio. Secy., John Laylin, Norwalk, Ohio.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Feb. 5-9. Eighth National Good Roads Show, in Boston, Mass. Secy., E. L. Powers, 150 Nassau St., New York City.

NATIONAL LIME MANUFACTURERS' ASSOCIATION.
Feb. 6-7. Annual meeting in New York City. Secy., F. K. Irvine, 537 South Dearborn St., Chicago.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Feb. 7-9. Midwinter convention in New York City. Secy., F. J. Hutchinson, 33 West 39th St., New York City.

MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY.
Feb. 7-9. Annual meeting in Minneapolis.

TENTH CHICAGO CEMENT SHOW.
Feb. 7-15. In Chicago. Under management of Cement Products Exhibition Co., 210 South La Salle St., Chicago.

AMERICAN CONCRETE INSTITUTE.
Feb. 8-10. In Chicago at La Salle. Secy., H. D. Hynds, 30 Broad St., N. Y.

AMERICAN ASSOCIATION OF ENGINEERS.
Feb. 8-10. In Chicago at the Hotel La Salle.

NATIONAL BUILDERS' SUPPLY ASSOCIATION.
Feb. 12-13. In Chicago at Sherman. Secy., L. F. Desmond, 1211 Chamber of Commerce, Chicago.

INDIANA SANITARY AND WATER-SUPPLY ASSOCIATION.
Feb. 14-15. Annual meeting in Indianapolis. Secy., W. F. King, Indianapolis, Ind.

WISCONSIN ENGINEERING SOCIETY.
Feb. 15-16. At Madison, Wis. Secy., L. S. Smith, 939 University Ave., Madison, Wis.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 19-22. Meeting in New York City. Secy., Bradley Stoughton, 29 W. 39th St., New York City.

SOUTHWESTERN CONCRETE ASSOCIATION.
Feb. 19-24. Southwestern Concrete Show in Kansas City, Mo. Address Chas. A. Stevenson, 1413 W. 10th St., Kansas City.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS.
Feb 20-21. Annual meeting in New Haven in Mason Laboratory. Secy., J. F. Jackson, New Haven.

IOWA STATE DRAINAGE ASSOCIATION.
Feb. 20-21. Meeting in Fort Dodge. Secy., M. F. P. Costelloe, Ames.

IOWA ENGINEERING SOCIETY.
Feb. 21-23. Annual meeting in Ames. Secy., J. H. Dunlap, Iowa City.

The Association of Ontario Land Surveyors will hold its annual meeting on Feb. 20 in Toronto. The secretary is L. V. Rorke, Toronto.

The New England Association of Gas Engineers will hold its forty-seventh annual meeting Feb. 14 and 15 in Boston at the Copley-Plaza Hotel. The secretary is N. W. Gifford, 38 Central Square, East Boston.

The American Society of Engineering Contractors will hold its annual meeting Jan. 19 and 20 in New York City at the Hotel Marlborough. At the banquet, on Jan. 20, motion pictures will be shown of some large construction work.

The Engineers' Society of Western Pennsylvania at its annual meeting on Jan. 9 elected the following officers: Chairman, George W. Nicholas; vice-chairman, R. A. Pendergross; secretary, Edward R. Dasher, 41 South Front St., Harrisburg, Penn.

Appliances and Materials

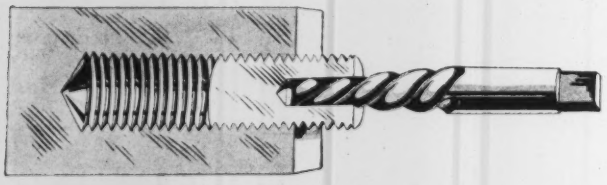
Self-Rotating Hole-Cleaning Hand Hammer Drill

A self-rotating hand hammer drill that automatically cleans the drilled hole has just been placed on the market by the Wood Drill Works, of Paterson, N. J. If the air going through the hollow steel does not clean the hole, as will be the case in certain rocks, a button at the top of the chest can be pushed to apply full air pressure to the drill point. When the button is released, the drill automatically starts again. The drill is self-oiling and has a soft-rubber grip on the handle to reduce the transmission of vibration to the operator.

* * *

Broken-Screw Extractor

One of the most ingenious and useful, but simple, tools made in recent years is the "Ezy-out" extractor for broken stud bolts, setscrews, etc., just announced by the Cleveland Twist Drill Co., Cleveland, Ohio. It is shown in the accompanying sketch. A hole is bored in the shank of the broken



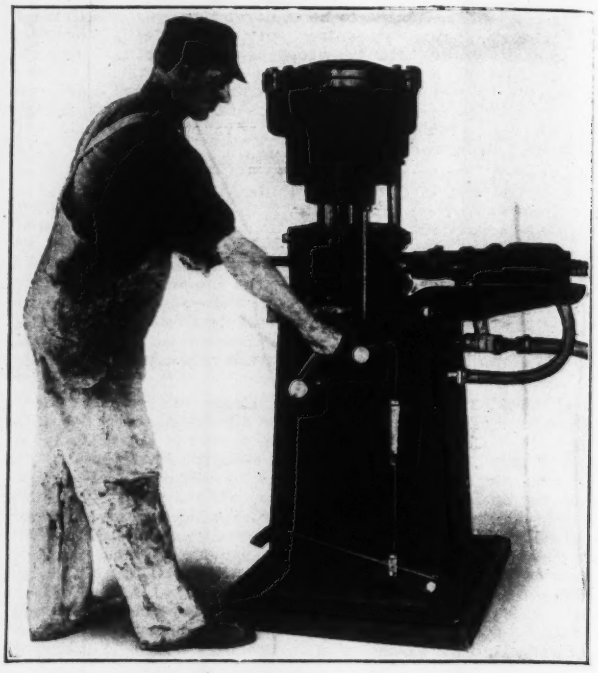
BROKEN SCREW EXTRACTOR

screw, and the tool is stuck in and twisted left hand. The left-hand, coarse, helical threads of the tool grip the sides of the bored hole and back out the old screw. A set of "Ezy-outs" consists of three tools of different sizes, which it has been found will meet the requirements of an ordinary shop or contractor.

* * *

Convenient Drill Sharpener

A new pneumatic drill sharpener has just been placed on the market by the Denver Rock Drill Manufacturing Co., of Denver, Colo. It is known as "Model DS-8" and has a pneumatic dolly and a swaging ram, mounted on a single pedestal. The ram cylinder is located directly above the die block, and the manufacturer claims that this arrangement is largely responsible for the effectiveness of the machine under low pressure.



NEW DENVER DRILL SHARPENER

The ram piston not only operates the swaging die, but is also used for clamping the steel when dollying, and it operates a steel cutter that is set at one side. The pin-pulling attachment, shown at the side of the pedestal, is operated by a pedal.

The exhaust is muffled in the hollow base. The dollying hammer is of the valve type; the changing of dollies is a simple operation, as there is no back pressure of the plunger when the hammer is not in operation. The machine is entirely controlled by a single lever, actuating two separate valves.

* * *

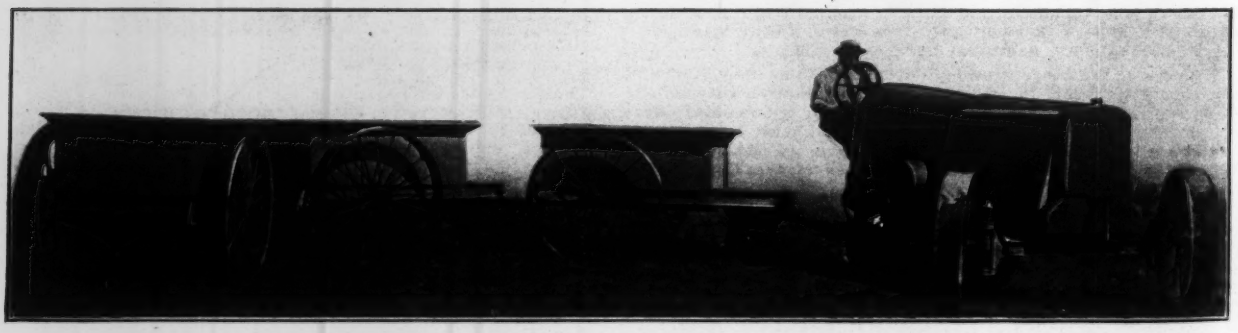
Steel Drafting-Room Furniture

A new type of construction has been devised by the Economy Drawing Table Co., of Toledo, to offset the increase in cost of material and to enable steel drafting-room furniture to be sold under prevailing prices. All joints are welded. The regular line includes drawing tables (with soft-pine top and filing drawers) and filing cases. Special designs are also made.

* * *

Three-Wheeled Dumping Trailer

The "Trakker-wagon," built by the A. W. Benson Manufacturing Co., Minneapolis, Minn., is a steel trailer designed especially for road-construction work. The accompanying view shows three of these trailers drawn by a small tractor. The bogey carrying the front-wheel journals also has coupler jaws, and a string of these wagons follows the tractor path. The bodies are bottom-dumping, and the leaves are hinged on the side frames. A handwinch with ratchet and pawl is mounted on the front for closing the bottom.



TRAIN OF TRACTOR AND THREE-WHEELED DUMPING TRAILERS